

Multiple-Discharger Variance Request CWC-X-X-X
State of Missouri
Department of Natural Resources

The Missouri Department of Natural Resources (department) is requesting a multiple-discharger variance for qualifying minor municipalities within the State of Missouri with a functional lagoon intended to facilitate compliance with water quality standards (WQS) for total ammonia nitrogen, as implemented through their National Pollutant Discharge Elimination System (NPDES) permit.

The applications submitted by the qualifying municipalities are pursuant to Section 644.061, RSMo. The request for the multiple-discharger variance is intended to cover minor municipalities that are Publicly Owned Treatment Works (POTW) within the State with a current technology of a lagoon that if upgraded to meet the underlying WQS for total ammonia nitrogen, the residents of the municipality would experience a substantial and widespread economic and social impact. All facilities included within this multiple-discharger variance meet the design requirements pursuant; 10 CSR 20-8.020 (13)(A)2., and 10 CSR 20-8.200(5)(C-D).

Department Recommendation

The department recommends that the Missouri Clean Water Commission (CWC) approve the multiple-discharger variance for the selected communities based on the following justifications:

The Missouri Clean Water Commission is among other things, legally authorized to grant individual variance from the requirements of the Missouri Clean Water Law and the regulations adopted under Section 644 RSMo, unless a variance is prohibited by any federal water pollution control act.

The department believes that not granting this multiple-discharger variance will cause a substantial and widespread economic and social impact to minor municipal dischargers without producing a corresponding long term sustainable benefit to the people or the environment. In order to meet the underlying WQS for total ammonia nitrogen as shown in 10 CSR 20-7.031(5)(B)7.C. and 10 CSR 20-7 Table B3, the qualifying municipalities would be required increase the user rates of the residents to an amount over two percent (2%) of their median household income. The U.S. Environmental Protection Agency (EPA) published a guidance in 1995 titled; Interim Economic Guidance for Water Quality Standards, which states, "...if the average annual cost per household exceeds 2.0 percent of median household income, then the project may place an unreasonable financial burden on many of the households within the community."

The department does not believe that the effect of this multiple-discharger variance will permit the continuation of a condition that unreasonably poses a present or potential threat to human health or the environment. The multiple-discharger variance requires the highest attainable effluent conditions that can be achieved without causing widespread social and economic impact.

The values for the highest attainable effluent conditions for total ammonia nitrogen were determined as described in the attached fact sheet titled, Highest Attainable Demonstration for a Wastewater Lagoon (Appendix A). This analysis provides a detailed report of the approach to determine the highest attainable effluent conditions for total ammonia nitrogen with lagoon treatment. The department recommends the seasonal average benchmark for total ammonia nitrogen effluent concentrations to be 2.3mg/L for the summer season and 3.2 mg/L for the winter season. Each municipality will receive a monthly sampling frequency and calculate the seasonal average in order to determine if the lagoon is meeting the seasonal benchmarks. The benchmark concentrations are not effluent limitations; benchmark exceedance, therefore, will not be considered a permit violation. However, failure to take reasonable action to achieve the benchmarks is a violation of the permit. Benchmark monitoring data is used to determine the overall effectiveness of control measures and to assist the permittee in knowing when additional corrective action(s) may be necessary to comply with the highest attainable effluent conditions established by this multiple-discharger variance. The highest attainable effluent conditions have been determined to be feasible and affordable.

All facilities included within this multiple-discharger variance meet the design requirements pursuant to 10 CSR 20-8.020 (13)(A)2., and 10 CSR 20-8.200(5)(C-D).

It is the department's opinion that this multiple-discharger variance will not relieve any qualifying community from any liability imposed by any other provision of the Missouri Clean Water Law or other statutes of Missouri for the commission or maintenance of a nuisance. Each facility received an on-site verification inspection by department staff prior to qualifying for the multiple-discharger variance. This inspection was completed in order to ensure that each lagoon had been designed and constructed in accordance with regulations and has the potential to meet the highest attainable effluent conditions for total ammonia nitrogen. Additionally, each NPDES permit requires all facilities to follow general criteria listed in 20 CSR 7.031(4).

The department believes a 10-year time period is necessary and reasonable to mitigate the substantial and widespread economic and social impact caused by the requirement to meet WQS for total ammonia nitrogen (10 CSR 20-7.031(5)(B)7.C. and 10 CSR 20-7 Table B3). The ten year time period will allow the qualifying communities to maintain existing water quality protections while allowing time for the following; adaptive management approaches, advances in treatment technologies, control practices, evaluation and removal of inflow and infiltration, sludge removal, pursue an increase in residential user rates to two percent (2%) of the municipality's median household income, and other changes in circumstances. The department has established the highest attainable effluent conditions for well-operated and maintained lagoon systems as the benchmarks described above. The qualifying municipalities will be reviewed at year five of the variance to ensure that the municipality has taken the appropriate steps to achieve the highest attainable effluent conditions and build capital to make the necessary wastewater treatment facility investments that will achieve the WQS for total ammonia nitrogen.

This variance request requires approval by EPA as it is a variance from Missouri WQS. The recent WQS amendment approved by the Commission states that a permittee or an applicant for a National Pollutant Discharge Elimination System (NPDES) for Missouri State Operating Permit may pursue a temporary variance to a WQS pursuant to either

Section 644 RSMo. In order to obtain EPA approval for a WQS variance for purposes of the federal Clean Water Act, the following additional provisions apply (40 CFR 131):

1. “A variance applies only to the applicant identified in such variance and only to the water quality standard specified in the variance. A variance does not modify an underlying water quality standard.”

This is a request to variance the water quality standards that apply to total ammonia nitrogen for the applicants listed in the Appendix section of this document. The underlying water quality standards for total ammonia nitrogen will remain as stated in 10 CSR 20-7.031(5)(B)7.C. and 10 CSR 20-7 Table B3. (see Appendices **X – X**)

2. “A variance shall not be granted if water quality standards will be attained by implementing technology-based effluent limits required under 10 CSR 20-7.015 of this rule and by implementing cost effective and reasonable best management practices for non-point source control.”

The qualifying municipalities within this multiple-discharger variance currently have a lagoon that is capable of meeting the technology based effluent limits listed in 10 CSR 7.015. However, it is well documented that meeting the technology based effluent limits for biochemical oxygen demand, total suspended solids and pH does not provide the treatment necessary to reduce the amount of total ammonia nitrogen in effluent to meet WQS.

The WQS for total ammonia nitrogen are not attainable through nonpoint source control. Each treatment works that is covered under this multiple-discharger variance does not receive excessive inflow and infiltration as defined by 40 CFR 133.103 (d) (3). (see Appendices **X – X**)

3. “A variance shall not be granted for actions that will violate general criteria conditions prescribed by 10 CSR 20-7.031(4).”

This multiple-discharger variance requires the qualifying municipalities to maintain existing water quality protections. The qualifying communities have committed to maintaining current operations in a way that will lead to the highest attainable effluent over the life of the multiple-discharger variance. The facilities will continue to be required to meet the technology based effluent limits established by 10 CSR 20-7.015 which have demonstrated compliance with the WQS general criteria. Furthermore these facilities have been in compliance with the general criteria conditions listed in 10 CSR 20-7.031(4) as required by their effective NPDES permits.

4. “A variance shall not be granted that would likely jeopardize the continued existence of any endangered or threatened species listed under section 4 of the Endangered Species Act or result in the destruction or adverse modification of such species’ critical habitat.”

It is not anticipated that the granting of this multiple-discharger variance to qualifying municipalities will jeopardize threatened or endangered species or result in the destruction or adverse modification of such species’ critical habitat. All communities that qualify for the

multiple-discharger variance have provided results from a Natural Heritage Review of the facility and the discharge location indicating that no federally-listed and state-listed threatened or endangered species (including those proposed for listing) or critical habitat (designated or proposed) is known to occur at or near the site of discharge. If the results show that a federally-listed and/or state-listed threatened or endangered species and/or their critical habitat is currently at or near the location of discharge, the qualifying municipality has provided a list of the threatened or endangered species (including those proposed for listing) and the justifications of why the multiple-discharger variance does not jeopardize their continued existence and/or the existence of their habitat. (see Appendices X-X)

5. “A variance may be granted if the applicant demonstrates that achieving the water quality standards is not feasible as supported by an analysis based on the factors provided in 40 CFR 131.10(g), or other appropriate factors.”

The basis for this multiple-discharger variance request is 40 CFR §131.10(g) Factor 6, in that meeting the WQS for total ammonia nitrogen would result in substantial and widespread economic and social impact. Each qualifying municipality has received a Cost Analysis for Compliance (CAFCOM) written by the department that concludes the residents of the community will incur a “high financial burden” and will result in residential user rates greater than two percent (2%) of the municipality’s median household income in order to comply with the WQS for total ammonia nitrogen. The estimated costs within the CAFCOM include treatment technologies that will meet a total ammonia nitrogen monthly average of 0.6 mg/L and a daily maximum of 1.7 mg/L. The department written CAFCOM uses CapDet to estimate the cost for the following treatment technologies: an extended aeration package plant, an extended aeration with triangular basin, an extended aeration oxidation ditch, and sequencing batch reactor as well as a no discharge option of a land application system. In support of the department’s CAFCOM, each qualifying community has completed the EPA written Uses and Variances – Evaluating Substantial and Widespread Economic and Social Impacts: Public Sector Entities spreadsheet with a result stating “impact is likely to be substantial.” Each community has also completed an alternatives analysis which consisted of determining the estimated costs to decentralize the utility, the estimated cost to regionalize, and the estimated cost to relocate the outfall to a receiving stream with appropriate mixing considerations in order to meet the WQS for total ammonia nitrogen. The estimated cost for regionalization and discharge relocation include the estimated costs of pipes, manholes, pump stations and an effluent forcemain. The alternatives analysis provided by the qualifying communities indicates that each alternative option will also result in residential user rates that will cause a substantial and widespread economic and social impact. (see Appendices X-X)

6. “In granting a variance, conditions and time limitations shall be set by the department with the intent that progress be made toward attaining water quality standards.”

The department believes a 10-year time period is necessary to mitigate the substantial and widespread economic and social impact caused by the requirement to meet WQS for total ammonia nitrogen. The ten year time period allows the qualifying municipalities to maintain existing water quality protections in order to comply with the benchmark criteria that the department has established as the highest attainable effluent conditions for total ammonia

nitrogen that a lagoon can meet. The highest attainable effluent conditions for total ammonia nitrogen capable of well operated and maintained lagoons were determined by the department to be seasonal averages of 2.3 mg/L for the summer season and 3.2 mg/L for the winter season. . All municipalities have committed to maintaining their existing lagoon infrastructure during the ten year timeframe of this multiple-discharger variance in accordance the facility design requirements pursuant to 10 CSR 20-8.020 (13)(A)2., and 10 CSR 20-8.200(5)(C-D).None of the treatment works listed within this multiple-discharger variance receive excessive inflow and infiltration as defined in 40 CFR 133.103 (d) (3).

The department believes allowing a community with substantial socioeconomic challenges a ten year time period to maintain their existing infrastructure, and build capital will ultimately achieve higher water quality at the point of discharge. The qualifying municipalities have committed to pursuing an increase to their current residential user rates to two percent (2%) of their median household income on or before year five of this multiple-discharger variance. This will allow each municipality an opportunity to build capital to put towards an upgrade, decentralization and/or close the existing infrastructure if an alternative to meet the WQS is known at that time. After the variance expires each qualifying municipality will receive a schedule of compliance within their NPDES permit to meet WQS or, if necessary, the community can re-apply for a variance.

7. “Each variance shall be granted only after public notification and opportunity for public comment. Once any variance to water quality standards is granted, the Department shall submit the variance, with an Attorney General Certification that the Clean Water Commission adopted the variance in accordance with state law, to the U.S. Environmental Protection Agency for approval.”

The multiple-discharger variance application, alternatives analysis, Natural Heritage Review completed by the Missouri Department of Conservation, the EPA written Uses and Variances – Evaluating Substantial and Widespread Economic and Social Impacts: Public Sector Entities spreadsheet (Factor 6 evaluation spreadsheet), department-written CAFCom, and department recommendation will be placed on the department’s website for public notice for a period of 30 days. The multiple-discharger variance and responses to comments will be provided to the Commission for their decision and forwarded to the Missouri Attorney General for certification. The multiple-discharger variance and supporting documentation will then be forwarded to EPA for approval.

USEPA has approved the use of variance when the state demonstrates that the following items are fulfilled:

1. There are individual variance provisions included in WQS.

Variance approval language is in WQS at 10 CSR 20-7.031(12).

2. The variance is subject to the same public review as other changes in WQS.

Section 303(c) of the CWA and the applicable federal regulations at 40 CFR § 131.20 describe the states' requirement to hold a public hearing for the purpose of reviewing WQS and notes that the information should be made available to the public prior to the hearing for the purpose of reviewing WQS. It is EPA's belief that variances, to be approved as changes to WQS, require the same opportunity for public review and comment. The department placed this multiple-discharger variance on public notice for 30 days. At the MONTH, YEAR CWC meeting, the department will present their recommendation, along with the public notice comments and responses. This multiple-discharger variance will be subject to additional public review during the next WQS triennial review as well as subsequent triennial reviews conducted by the department until the multiple-discharger variance expiration.

3. Meeting the WQS is unattainable based on one or more of the factors listed in 40 CFR § 131.10(g) for removing the designated use.

As described in Section 5.3 of the EPA Water Quality Standards Handbook (Second Edition, 1994), variances to WQS involve the same substantive and procedural requirements as removing a designated use, but specifically identify the applicable discharger(s), pollutant(s), and time limit. The substantive and procedural requirements include a use attainability demonstration identifying one of the factors listed in federal regulations (40 CFR § 131.10(g)) for removing a designated use and target achievement of the stream's highest attainable use and the associated criteria during the variance period. As described above, the basis for this variance request is 40 CFR § 131.10(g) Factor 6, meaning each qualifying municipality has submitted justification that complying with the total ammonia nitrogen WQS would result in a widespread economic and social impact. The multiple-discharger variance application includes the following for each community: the department written CAFCom, the community completed alternatives analysis, and the community completed Uses and Variances – Evaluating Substantial and Widespread Economic and Social Impacts: Public Sector Entities spreadsheet (Factor 6 evaluation spreadsheet). Each of these documents describes in detail each municipality's unique financial situation and how the WQS for total ammonia nitrogen would cause a substantial and widespread economic and social impact. (see Appendices X-X)

4. The variance secures the highest level of water quality attainable short of achieving the standard.

This multiple-discharger variance has been sought since the technologies available to meet the WQS for total ammonia nitrogen, specifically 10 CSR 20-7.031(5)(B)7.C. and 10 CSR 20-7 Table B3, would cause substantial and widespread economic and social impact. The technologies that the department currently estimates the cost for within our CAFCom are: an extended aeration oxidation ditch, sequencing batch reactor, extended aeration with triangular basin and an extended aeration package plant. All technologies listed have the capability to meet the current WQS and the future WQS (where mussels of the family Unionidae are present or expected to be present) for total ammonia nitrogen. There is also an opportunity to convert to a no discharge land application system. Each community has also completed an alternatives analysis which analyzes the estimated costs of decentralization of the wastewater utility, relocation of the outfall, and regionalization. However, each qualifying municipality has provided significant

information to show the cost of the preceding technologies and alternatives would result in substantial and widespread economic and social impact. (see Appendices X-X)

The department has determined the highest attainable effluent conditions to be seasonal averages of 2.3 mg/L for summer and 3.2 mg/L for winter as described in the attached fact sheet titled, Highest Attainable Demonstration for a Wastewater Lagoon (Appendix A). The highest attainable effluent conditions will be required within the NPDES permit as a benchmark with monthly sampling requirements, as explained above.

The ten year variance will allow each municipality time to work on improving their existing infrastructure while building capital to put toward future improvements or plans to upgrade, decentralize, regionalize or another alternative that will be known at that time. Each qualifying municipality has committed to take an aggressive approach to raise capital for future investments relating to wastewater by pursuing an increase to their residential sewer rates to two percent (2%) of their median household income by the end of the fifth year of the multiple-discharger variance. Each municipality has committed to maintain the design guidelines for optimization of lagoon treatment.

5. That advanced treatment and alternative effluent control strategies have been considered.

The qualifying communities for this multiple-discharger variance do not have the financial capabilities to consider advanced treatments, as the basis for this multiple-discharger variance application is 40 CFR § 131.10(g) Factor 6. The qualifying communities have provided the department with justifications of why alternative control strategies are not feasible for their communities (see Appendices X-X). The alternative control strategies were considered by each municipality, but not limited to; relocation of the existing outfall to a receiving stream that has the loading capacity in which the discharge will not cause an excursion of WQS, decentralization of the utility, and regionalization of the utility.

Variance Timeframe:

The timeframe for this multiple-discharger variance shall be for ten years, beginning upon variance incorporation in the qualifying communities' NPDES permit. The timeframe as well as other aspects of this variance are subject to review during each WQS triennial review during the duration of this multiple-discharger variance.

If a municipality has failed to implement steps to maintain the highest attainable effluent conditions for total ammonia nitrogen, or fails to pursue an increase on their residential sewer rates to two percent (2%) of their median household income within five years, the community will no longer qualify for the multiple-discharger variance and will receive the current WQS for total ammonia nitrogen and applicable schedules of compliance in their NPDES permit at that time.

Cost Analysis for Compliance (CAFCom):

The CAFCom is based on data available to the department as provided by the permittee and data obtained from readily available sources. For the most accurate analysis, it is essential that the permittee provides the department with current information about the City's financial and socioeconomic situation. The permittee provides the department with a filled out financial questionnaire during the renewal application process. The department currently uses software to estimate the cost for reconstruction of a treatment plant titled CAPDETWORKS (CapDet). CapDet is a preliminary design and costing software program from Hydromantis for wastewater treatment plants that uses national indices, such as the Marshall and Swift Index and Engineering News Records Cost Index for pricing in development of capital, operating, maintenance, material, and energy costs for each treatment technology. CapDet is used to estimate the cost to construct and install an extended aeration oxidation ditch, an extended aeration package plant, an extended aeration with triangular basin, a sequencing batch reactor, as well as a no discharge land application system. The CAFCom incorporates eight criteria regarding the community's financial capabilities, project user rates as a percentage of the residential median household income, socioeconomic data and other relevant information. The Financial Capability Matrix as described in USEPA's 1997 Combined Sewer Overflows Guidance for Financial Capability Assessment and Schedule Development is used within the document to evaluate the level of financial burden the upgrade could potentially place on a community. The department uses all information within the CAFCom to determine an appropriate schedule of compliance to meet the final effluent limits within the Missouri State Operating Permit (MSOP). The permits that are incorporated into the multiple-discharger variance have a draft permit with a CAFCom that concludes the upgrades necessary to comply with the final effluent limits will result in a "High Burden" with potential user rates above 2 % of the residential median household income.

Additional Consideration:

If, during the term of this multiple-discharger variance, less expensive pollution control technology is developed and determined to be technologically and economically feasible, the department will evaluate and consider options associated with the additional pollution controls. Consideration must be given if prohibitive upgrades and financial commitments have occurred on the part of the City as set forth in the permit or this variance.

This page intentionally left blank

Highest Attainable Demonstration for a Wastewater Lagoon

Intent

Wastewater pond systems (lagoons) are an important wastewater treatment technology in terms of cost effectiveness and operational viability. Lagoons that are properly designed, operated, and maintained can be protective of water quality where instream assimilative capacity exists. The intent of this memo is to establish highest attainable effluent conditions for ammonia to support the multiple-discharge variance request for disadvantaged communities that will experience a substantial and widespread economic and social burden with respect to costs associated with compliance with total ammonia nitrogen water quality standards. Many of the existing neglected systems can pose a threat to surface water. Therefore, it is imperative that the highest attainable effluent conditions be protective of existing water quality.

The analysis below provides a detailed report of the approach to determine the highest attainable effluent conditions for total ammonia nitrogen. The department recommends the benchmark for total ammonia nitrogen effluent concentrations to be 2.3 mg/L for the summer season and 3.2 mg/L for the winter season.

Statement of Issue

Small communities have a small rate base and lack the funds to build and maintain advanced treatment system, such as activated sludge, to achieve the current and EPA recommended ammonia water quality criteria within the time period afforded by a compliance schedule.

The U.S. Environmental Protection Agency (EPA) published a wastewater ponds design and operation manual in 2011 which describes their finding of performance achievements associated with design details that might be employed for existing lagoons. Possible improvements include sludge removal and enhanced aerations. EPA has stated their support for lagoons as a treatment option particularly for communities that could not afford to match even the construction grants that were offered at that time to bring communities of all sizes some level of wastewater treatment.

Highest Attainable Determination Approach

The department's approach utilizes the most recent design document published by EPA in 2011, entitled "Principles for Design and Operations for Wastewater Treatment Pond Systems for Plant Operators, engineers, and managers" (EPA/600/R-11/088). EPA recognizes that well designed lagoons provide reliable, low cost, and relatively low maintenance wastewater treatment for municipalities. Although the basic design of lagoons has not changed for the last 30 years, the department has also examined some of the innovations and improvements in light of the economic considerations. This document will allow communities that are struggling financially to make the most cost effective improvements to their wastewater treatment facilities and achieve the highest attainable effluent conditions during the period of the multiple-discharger variance. It is expected that these treatment improvements will not result in degradation to

existing water quality, but instead will improve water quality by allowing disadvantaged municipalities time to utilize their existing infrastructure at a level that produces the highest attainable effluent conditions. This approach will allow these communities time to financially prepare for future upgrades or other alternatives available after the variance expires. This determination is not intended to address facilities that discharge to waters that are on the 303(d) list or where a Total Maximum Daily Load (TMDL) is developed.

Lagoon Enhancement Options

There are a number of emerging technologies for retrofitting lagoon systems to address ammonia. These systems involve various ways of adding oxygen, increasing biomass, covering to retain heat, and using various configurations and equipment to provide areas within the lagoon for fixed film growth. Several of these systems are being piloted in Missouri. However, all of these technologies are associated with considerable expense. For the universe of smaller lagoon systems that are being addressed by the multiple-discharger variance, land application systems have proven to be less expensive than these enhanced options. The department expects the technology of lagoon enhancements will continue to evolve, but at this time the department is not aware of any that will reliably meet water-quality based ammonia limits that are universally affordable.

Discussion on Types of Lagoons

The EPA sponsored studies on nitrogen removal in both facultative and aerated lagoons. Ammonia removal in lagoons can be carried out through volatilization, assimilation into algal biomass, and biological nitrification. Nitrogen removal is dependent upon pH, detention time, and temperature. Data from these studies show that the reduction of ammonia increases when pH exceeds 8.0. However, as pH increases the amount of un-ionized ammonia, which is toxic to fish, increases. Inadequate detention time is believed to be a major factor in poor ammonia removal. According to the EPA, typical detention times range from 20 to 180 days for facultative lagoons and 10 to 20 days for aerated or partial mix lagoons. Temperature is not a factor which can easily be manipulated for ammonia removal in lagoons.

Facultative lagoons are effective in removing settleable solids, BOD, pathogens, fecal coliform, and, to a limited extent, ammonia. They are easy to operate and require little energy. Due to their shallow design depth, a large amount of land is required to construct a facultative lagoon and sludge accumulation tends to be higher than deeper systems. Ammonia levels fluctuate in facultative lagoons. Increasing the surface area of the facultative pond will improve the performance of the system. A well operating facultative lagoon can achieve and occasionally exceed 90% ammonia removal.

Aerated lagoons can provide significant nitrification of ammonia if they provide adequate resident time. They are typically shallow, allowing light to penetrate the full depth. Oxygen is provided by photosynthesis and surface reaeration. Mechanical oxygen addition can allow for more treatment in less space. Nitrogen can undergo a number of chemical and physical processes. Ammonia removal in aerated lagoons varies depending on detention time and

typically is not as effective as facultative lagoons because they are operated with less detention time and the conditions favor heterotrophic bacteria instead of nitrifiers.

Lagoon Design Guide Sizing (10 CSR 20-8.020(13)(A)2. or 10 CSR 20-8.200(5)(C-D)

Facultative lagoons are designed for a minimum of 120 day total storage. The first cell must be designed with a minimum surface area at 3 foot depth based on Biochemical Oxygen Demand (BOD) loading of 34 pounds per acre. BOD is assumed to be 0.17 pounds per person. The minimum area ratio of the second and third cell to the first is 0.3 and 0.1 respectively with a minimum surface area requirement of 1000 ft². in the third cell. This surface area will normally equate to about 90 days detention time in the first cell with about 25 days in the second and 5 in the third cell, Facultative lagoons normally have a depth between three and six feet in the first and second cells with a depth of up to eight feet in the third cell.

On lagoons that have been in operation for over twenty years, measurement of the sludge depth is required, as sludge removal is recommended when the sludge depth is greater than 1/3 of the operating depth of the lagoon cell. Most lagoons are constructed with an inside berm slope of three horizontal to one vertical. Lagoons are designed to meet equivalent-to-secondary effluent limitations for BOD and total suspended solids and with this treatment is limited ammonia removal, but no actual design criteria for ammonia treatment.

In Table A-1 and summarized below is a table of approximate sizes of a three-cell lagoon treatment system. The assumptions used in the calculations were 3:1 berm slopes, 2:1 length to width, and 5.5 foot water depth. Although actual dimensions of individual lagoon systems vary, the actual volumes and surface areas of the lagoons should be comparable with the calculated values for surface areas and volumes. The first cell surface area is based on the three-foot water depth. The surface areas of the second and third cells are the top operating depth water levels.

Design Pop Equiv.	Flow (gpd)	First Cell		Second Cell		Third Cell	
		Surface Area (ft ²)	Volume (gal)	Surface Area (ft ²)	Volume (gal)	Surface Area (ft ²)	Volume (gal)
100	10,000	21,780	891,524	8,100	247,848	2,700	51,189
200	20,000	43,560	1,768,563	15,128	510,979	5,043	120,132
300	30,000	65,340	2,658,452	22,110	739,060	7,370	194,511
400	40,000	87,120	3,549,304	29,021	973,187	9,674	271,281
500	50,000	108,900	4,440,773	35,888	1,218,563	11,963	349,578
600	60,000	130,680	5,332,679	42,722	1,474,897	14,241	428,961
750	75,000	163,350	6,671,137	52,931	1,861,211	17,644	549,519
1,000	100,000	217,800	8,903,025	69,863	2,508,470	23,288	753,238
1,500	150,000	326,700	13,369,441	103,534	3,810,976	34,511	1,167,220

Aerated lagoons are normally smaller and only have two cells. The first cell normally has approximately 44 days of storage volume. Aerated cells shall be followed by a polishing cell

with a volume of 0.3 of the volume of the aerated cell. Therefore the volumes of an aerated lagoon are about half the volumes listed of the first two cells in the table above or Appendix A. The design guide differs on the actual volumes with the second cell of small lagoons being smaller in accordance with 10 CSR 20-8.020(13)(A)2.B. and the first cell of large lagoons being

smaller in accordance with 10 CSR 20-8.200(5)(D). Aeration equipment must be sized for 1.3 pounds of oxygen per pound of BOD and to maintain a dissolved oxygen level of two milligram per liter in the aerated cell. Again, note the design guide does not have criteria for ammonia treatment. Minimum size for mechanical aerators is ten horsepower per million gallons in the aerated cell. Oxygen transfer efficiency of the aeration equipment must be accounted for.

Other Lagoon Design Guide Requirements (10 CSR 20-8.020(13)(A)3.- 6. or 10 CSR 20-8.200(6)):

1. Lagoon seal constructed of compacted clay soil or other impermeable material.
2. Diversion of surface water runoff from the lagoon via berms, ditches, terraces, etc.
3. Berm Height provides two feet of freeboard above water level.
4. Regular mowing of lagoon area, which has good vegetated cover. No deep rooted vegetation.
5. Transfer and discharge piping must withdraw below water surface to prevent discharge of scum or floating materials.

Development of Benchmark Limits

The department is currently unaware of any suitable or accepted method to determine the highest attainable effluent conditions for total ammonia nitrogen for lagoons. This analysis examines current lagoon performance in an attempt to determine the highest attainable effluent conditions for total ammonia nitrogen that a well operating lagoon could achieve. Total ammonia nitrogen, total suspended solids (TSS) and biochemical oxygen demand (BOD) effluent concentrations from discharge monitoring report (DMR) data reported by Missouri lagoons with design flows of less than 150,000 gallons per day were gathered into a dataset. While the final multiple-discharger variance will not have a limit on flow, 150,000 gallons was used for the data analysis because it was assumed that municipalities with smaller lagoons would be in need of the variance and the data from these lagoons would provide the most accurate scenario of the highest attainable effluent conditions. All facility types included in the dataset can be found in Table A-3. The dataset did not include any facilities that had an additional treatment system that the department is aware of. Several communities throughout Missouri are facing new water quality requirements for ammonia that were not factored into design specifications when many of the existing ponds were constructed. It is assumed that the existing ponds provided some ammonia treatment when they were initially constructed, but over time as sludge built up in their systems, ammonia removal effectiveness decreased. According to Metcalf and Eddy¹, total concentrations of organic and ammonia nitrogen in municipal wastewaters is typically in the range from 25 to 45 mg/L as nitrogen based on a flowrate of 380 L/capita·d (100 gal/capita·d). Therefore, in this data analysis, an influent ammonia concentration of 35 mg/L was assumed.

¹ Metcalf & Eddy, Inc., *Wastewater Engineering: Treatment and Resource Recovery*. 5th ed. (New York: McGraw Hill Education, 2003), 618.

The entire lagoon DMR dataset was first evaluated using only the monthly average concentration for Ammonia. The monthly average was chosen because effluent limits are often based off of monthly averages. However, several of the facilities in this data set are small facilities, which typically only collect samples once a month. The effluent concentrations had a range from 0

milligrams per liter (mg/L) to 83.4 mg/L of ammonia and an average of 5.1 mg/L. The data was then organized by facility and averaged. The averages of all of the facilities were then evaluated and found to have a range from 0.1 mg/L to 28 mg/L and an average of 4.9 mg/L

Current ammonia effluent limits utilized by the department are based on seasons, with summer being from April to September and winter being from October to March. Since the goal of this technical review is to determine benchmark effluent limits, the original dataset was organized and divided into these two season categories, separated by facility, and then averaged. In the summer averages dataset the minimum was 0.1 mg/L, the average was 3.2 mg/L and the maximum was 25 mg/L. The winter averages dataset had a minimum of 0 mg/L, an average of 6.1 mg/L and a maximum of 39.9 mg/L.

The data was then narrowed down further with only those facilities that have DMR data within compliance for BOD and TSS being included in the dataset. In order to determine if a facility was in compliance with BOD and TSS limits the monthly average effluent concentrations reported in the DMR were organized by facility and averaged and then evaluated against the BOD limit of 45 mg/L and the facilities respective TSS limits given in the DMR report, which ranged from 30 mg/L to 80 mg/L. Any facility that had an average that exceeded the limits for either BOD or TSS was removed from the dataset. It was found that 51 of the 181 facilities evaluated, or 28.2%, were out of compliance with either BOD or TSS. The summer averages dataset still had the same range of 0.1 mg/L to 25 mg/L, but now an average of 3.4 mg/L. The winter dataset also had the same range of 0 mg/L to 39.9 mg/L, but averaged 6.1 mg/L.

In an attempt to get a better representation of the highest attainable effluent conditions for lagoons the dataset was narrowed down to only include facilities with average effluent concentrations below 10 mg/L. A concentration of 10 mg/L was used because it is known that lagoons can achieve single digit effluent concentrations of ammonia. Graphs A-1 through A-4 display an example of the facilities that can consistently meet total ammonia nitrogen levels of lower than 10 mg/L. This removed 10 facilities out of the 125 facilities in the summer dataset, or 8%, and 26 facilities out of the 127 facilities in the winter dataset, or 20.5%. The removal of these facilities does not mean that they will not be eligible for the multiple-discharger variance, but were removed in an attempt to determine the highest attainable effluent conditions or total ammonia nitrogen a lagoon can achieve. The summer dataset had a range from 0.1 mg/L to 9.2 mg/L and an average of 2.3 mg/L. The winter dataset had a range from 0 mg/L to 9.5 mg/L and an average of 3.2 mg/L. The percentile breakdown of this dataset can be found in Table A-4. Also, the dataset only included facilities near or in compliance for TSS and BOD and had average effluent ammonia concentrations less than 10 mg/L, which is known to be achievable for lagoons.

It is the department's opinion that though the final average ammonia values are suitable for the multiple-discharger variance due to the fact that they are based off of current lagoon performance and are seasonally based in the same manner as current water quality standards.

In conclusion the department recommends a benchmark for total ammonia nitrogen effluent concentrations of 2.3 mg/L for the summer season and 3.2 mg/L for the winter season.

Table A-1: Approximate Lagoon Sizing for Three-Cell Lagoon

Three-Cell Lagoon (Based on Design Guides – 10 CSR 20-8)

Design		First Cell		Second Cell		Third Cell	
Pop Equiv.	Flow (gpd)	Surface Area (ft ²)	Volume (gal)	Surface Area (ft ²)	Volume (gal)	Surface Area (ft ²)	Volume (gal)
50	5,000	10,890	452,766	4,455	118,812	1,485	25,075
100	10,000	21,780	891,524	8,100	247,848	2,700	51,189
150	15,000	32,670	1,324,209	11,594	378,611	3,865	84,407
200	20,000	43,560	1,768,563	15,128	510,979	5,043	120,132
250	25,000	54,450	2,213,353	18,630	619,754	6,210	156,938
300	30,000	65,340	2,658,452	22,110	739,060	7,370	194,511
350	35,000	76,230	3,103,785	25,572	852,092	8,524	232,666
400	40,000	87,120	3,549,304	29,021	973,187	9,674	271,281
450	45,000	98,010	3,994,975	32,459	1,090,866	10,820	310,272
500	50,000	108,900	4,440,773	35,888	1,218,563	11,963	349,578
550	55,000	119,790	4,886,679	39,308	1,346,588	13,103	389,153
600	60,000	130,680	5,332,679	42,722	1,474,897	14,241	428,961
700	70,000	152,460	6,224,916	49,533	1,732,234	16,511	509,165
800	80,000	174,240	7,117,416	56,324	1,990,366	18,775	590,020
900	90,000	196,020	8,010,131	63,100	2,249,146	21,033	671,406
1,000	100,000	217,800	8,903,025	69,863	2,508,470	23,288	753,238
1,100	110,000	239,580	9,796,072	76,614	2,768,258	25,538	835,450
1,200	120,000	261,360	10,689,253	83,356	3,028,447	27,785	917,991
1,350	135,000	294,030	12,029,237	93,453	3,419,379	31,151	1,042,333
1,500	150,000	326,700	13,369,441	103,534	3,810,976	34,511	1,167,220
1,750	175,000	381,150	15,603,519	120,306	4,464,862	40,102	1,376,367
2,000	200,000	435,600	17,838,012	137,048	5,120,003	45,683	1,586,544
2,250	225,000	490,050	20,072,844	153,765	5,776,171	51,255	1,797,561
2,500	250,000	544,500	22,307,960	170,461	6,433,197	56,820	2,009,282

Table A-2: Approximate Lagoon Sizing for One- and Two-Cell Lagoons

Alternate Lagoons – One- and Two-Cell Lagoons (Not per Design Guides – 10 CSR 20-8)

Design Pop Equiv.		Two-Cell Lagoon				One-Cell Lagoon	
		First Cell		Second Cell		Single Cell	
	Flow (gpd)	Surface Area (ft ²)	Volume (gal)	Surface Area (ft ²)	Volume (gal)	Surface Area (ft ²)	Volume (gal)
50	5,000	10,890	493,590	4,560	108,307	10,890	600,000
100	10,000	21,780	982,333	8,100	228,684	21,780	1,200,000
150	15,000	32,670	1,471,077	11,969	369,063	32,670	1,800,000
200	20,000	43,560	1,959,820	15,556	503,804	43,560	2,400,000
250	25,000	54,450	2,448,563	19,105	639,961	54,450	3,000,000
300	30,000	65,340	2,937,306	22,627	777,123	65,340	3,600,000
350	35,000	76,230	3,426,049	26,129	915,047	76,230	4,200,000
400	40,000	87,120	3,914,793	29,614	1,053,573	87,120	4,800,000
450	45,000	98,010	4,403,536	33,086	1,192,592	98,010	5,400,000
500	50,000	108,900	4,892,279	36,547	1,332,023	108,900	6,000,000
550	55,000	119,790	5,381,022	39,999	1,471,806	119,790	6,600,000
600	60,000	130,680	5,869,765	43,442	1,611,894	130,680	7,200,000
700	70,000	152,460	6,847,252	50,308	1,892,840	152,460	8,400,000
800	80,000	174,240	7,824,738	57,151	2,174,638	174,240	9,600,000
900	90,000	196,020	8,802,225	63,975	2,457,133	196,020	10,800,000
1,000	100,000	217,800	9,779,711	70,783	2,740,210	217,800	12,000,000
1,100	110,000	239,580	10,757,197	77,578	3,023,784	239,580	13,200,000
1,200	120,000	261,360	11,734,684	84,361	3,307,789	261,360	14,400,000
1,350	135,000	294,030	13,200,913	94,518	3,734,491	294,030	16,200,000
1,500	150,000	326,700	14,667,143	104,655	4,161,906	326,700	18,000,000
1,750	175,000	381,150	17,110,859	121,514	4,875,577	381,150	21,000,000
2,000	200,000	435,600	19,554,575	138,338	5,590,594	435,600	24,000,000
2,250	225,000	490,050	21,998,291	155,131	6,306,712	490,050	27,000,000
2,500	250,000	544,500	24,442,007	171,900	7,023,750	544,500	30,000,000

Assume

3:1 side slopes

2:1 Length to Width

6 foot depth for Two-Cell Lagoon

Minimum Surface Area of First Cell calculated based on

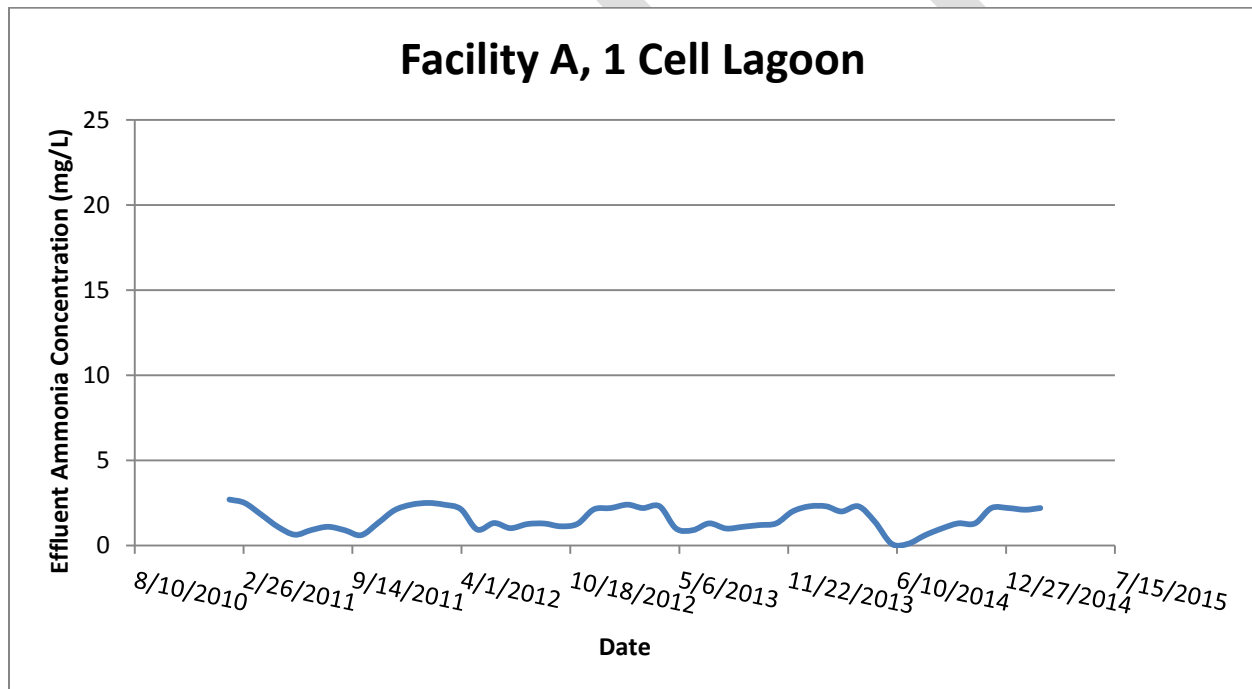
10 CSR 20-8.020(13)(A)2.A. or 8.200(5)(C)

Table A-3: Types of Facilities Included in Lagoon Data Analysis

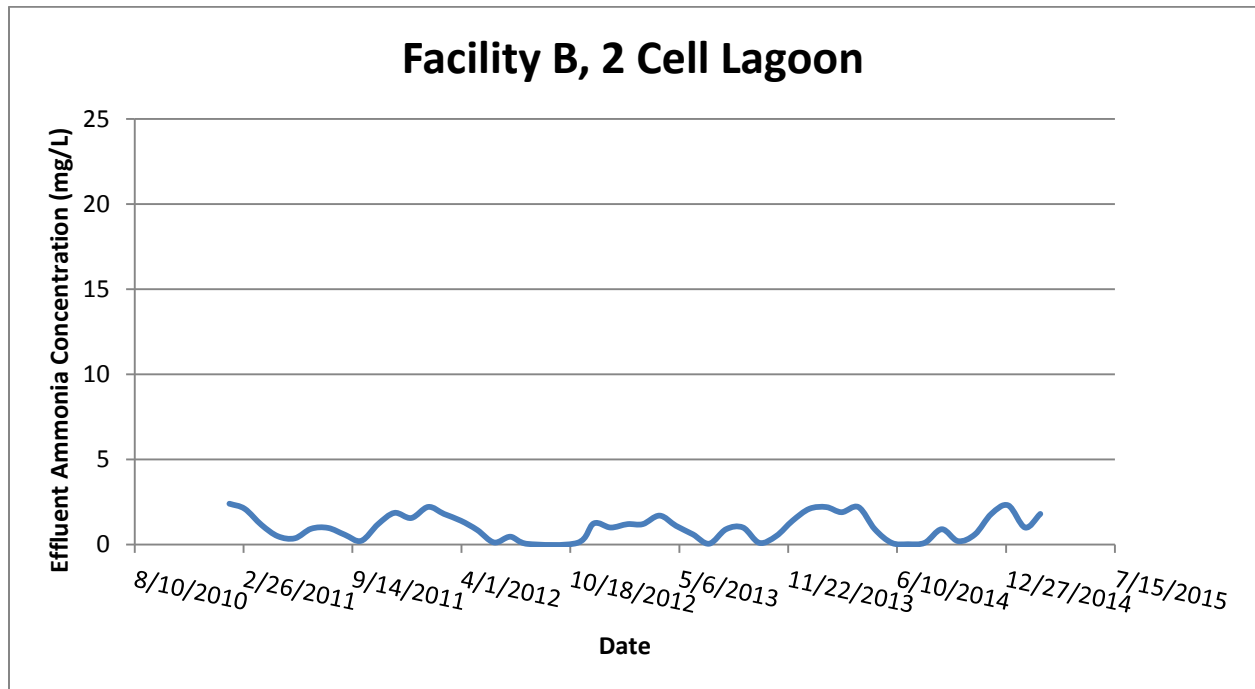
Treatment Type	Aerated	Facultative	Total
1 cell	4	11	15
2 cell	17	14	31
3 cell	15	95	110
4 cell	3	17	20
5 cell	1	1	2
Aerated Lagoon	3	0	3
	43	138	181

Graphs of Effluent Concentrations at Facilities over Time: The facility graphs are examples of different types of lagoon performance in Missouri. Facility graphs have normalized y-axis with a maximum of 25 mg/L to display lagoon performance.

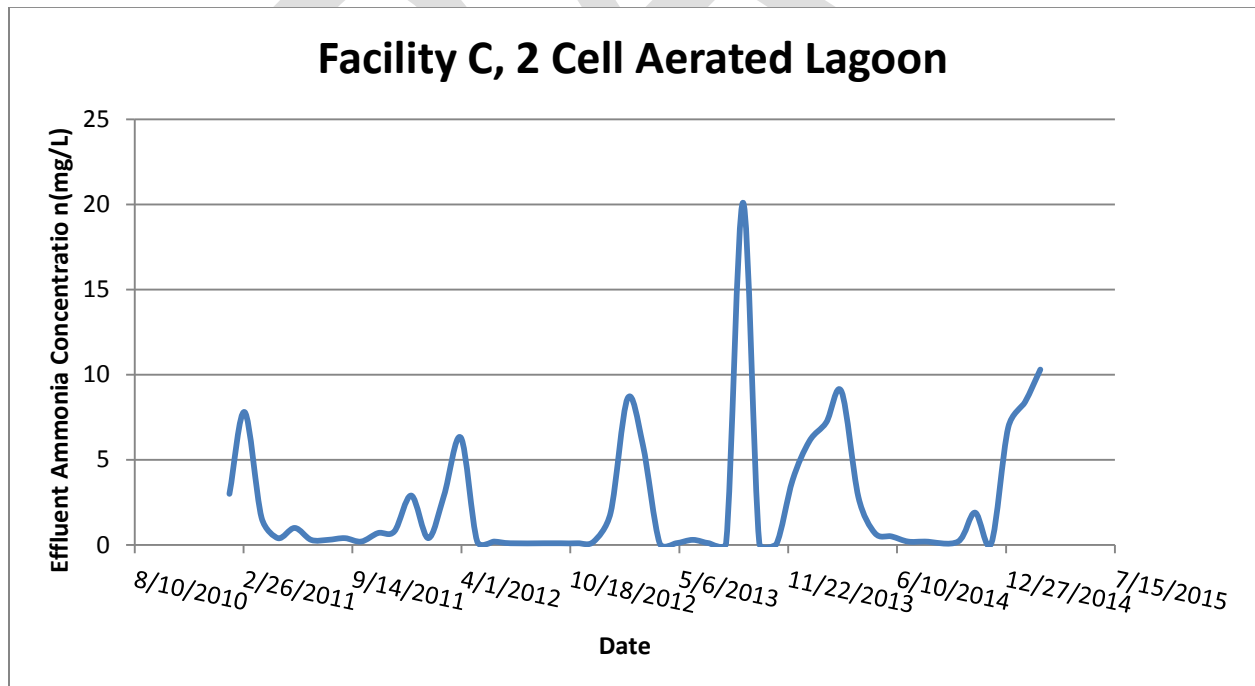
Graph A-1: One-Cell Lagoon



Graph A-2: Two-Cell Lagoon



Graph A-3: Two-Cell Aerated Lagoon



Graph A-4: Three-Cell Aerated Primary Lagoon

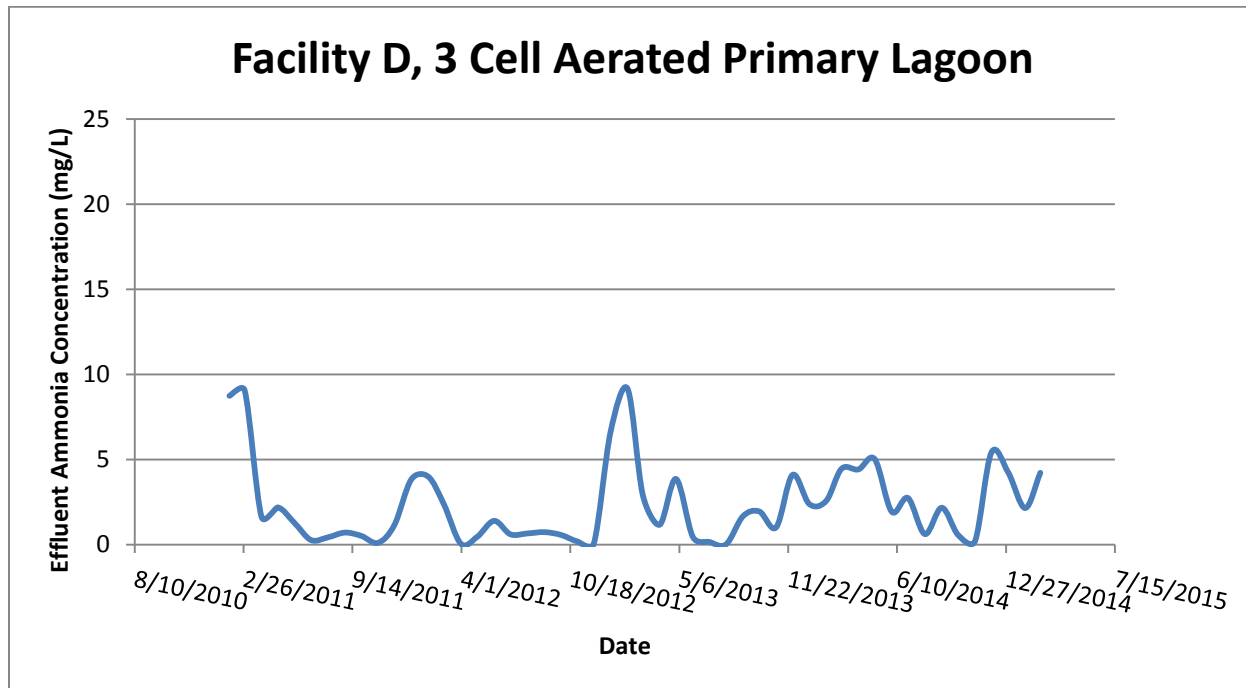


Table A-4: Percentile Breakdown of Final Ammonia Effluent Concentration Data

PERCENTILE	ALL DATA	SUMMER	WINTER
20	0.9	0.7	0.8
25	1.1	0.8	1.2
50	2.1	1.7	2.5
75	4.0	3.5	5.4
80	4.9	3.8	6.1
90	6.0	5.8	7.0
95	7.0	7.1	7.9

This page intentionally left blank

Appendix B:



MISSOURI DEPARTMENT OF NATURAL RESOURCES
WATER PROTECTION PROGRAM
MULTIPLE-DISCHARGER VARIANCE APPLICATION

NOTE ►	Any Municipal Publicly Owned Treatment Works with a functional lagoon is eligible for the Multiple-Discharger Variance.	
1. GENERAL INFORMATION		
FACILITY NAME	PERMIT NUMBER (s) #MO-	
MAILING ADDRESS	COUNTY	
2. GENERAL INFORMATION		
2.1 Is this facility a Municipal Publicly Owned Treatment Works? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>If No, this facility does not qualify for the multiple-discharger variance. If necessary, please apply for a site-specific variance.</i>		
2.2 Population served:		
2.3 Design Flow in gallons per day:		
2.4 Actual Flow in gallons per day: <i>Inflow and Infiltration \geq 275 gallons per capita per day is considered excessive.</i>		
2.5 Wastewater Treatment Facility Type: <i>To qualify for the multiple-discharger variance, the current treatment type must fit one of the listed categories.</i>	<input type="checkbox"/> Lagoon: <input type="checkbox"/> Single Cell <input type="checkbox"/> Multi-Cell	
2.6 Age(s) of current Wastewater Treatment Facility Infrastructure(s):		
2.7 Receiving Stream at the point of discharge from the wastewater treatment facility:		
3. CURRENT NPDES PERMIT INFORMATION		
3.1 Does your municipality currently have an application for renewal of your NPDES permit submitted to the Department of Natural Resources? <i>(If No, please submit an application for renewal 180 days before the expiration date of your current permit, along with the completed financial questionnaire and this multiple-discharger variance applicant questionnaire)</i>	<input type="checkbox"/> Yes <input type="checkbox"/> No	
3.2 Does your site-specific NPDES permit currently contain final effluent limits for Ammonia as N? <i>(If Yes, answer 3.3, If No, skip to 4.1)</i>	<input type="checkbox"/> Yes <input type="checkbox"/> No	
3.3 Is the municipality currently working toward meeting the NPDES permitted schedule of compliance to comply with the final effluent requirements for Ammonia as N? <i>(If Yes, please attach a document that includes the steps taken to meet these requirements)</i>	<input type="checkbox"/> Yes <input type="checkbox"/> No	
4. FINANCIAL INFORMATION		
4.1 Has the department provided your municipality with a draft or final version of a "Cost Analysis for Compliance" (CAFCOM) or previously titled "Affordability Analysis," that anticipates an upgrade to a land application system or a mechanical treatment plant will result in residential user rates above two percent (2%) of the municipality's median household income ? <i>CAFCOM/Affordability Analysis is found in the appendix section of the most recent draft of the NPDES permit Fact Sheet</i>	<input type="checkbox"/> Yes <input type="checkbox"/> No	

<p>4.2 Please complete and submit the EPA spreadsheet; <u>Uses and Variances – Evaluating Substantial and Widespread Economic and Social Impacts: Public Sector Entities</u>. Does the Substantial Impacts Matrix indicate the pollution control options are likely to impose a substantial and economic and social impact on the residents of the municipality? Projected cost information from the most recent draft of the CAFCom/Affordability Analysis can be used to complete this form. EPA spreadsheet can be found at: http://water.epa.gov/scitech/swguidance/standards/economics/upload/usespublic.xlsx</p>	<input type="checkbox"/> Yes <input type="checkbox"/> No
<p>4.3 In order to qualify for the multiple-discharger variance, each municipality will need to pursue an increase in residential sewer rates at an amount of two percent (2%) of the median household income (MHI) by the end of the fifth year of the multiple-discharger variance. Is your current residential user rate at or above 2% of your MHI?</p>	<input type="checkbox"/> Yes <input type="checkbox"/> No
<p>5. Threatened or Endangered Species</p>	
<p>5.1 Provide an attached list of all federally and state-listed threatened or endangered species (designated or proposed) and/or the critical habitats of those species (designated or proposed) that are known to occur on or near the site of discharge. (Please see Fact Sheet below titled; <u>Natural Heritage Review Report</u>. Attach additional sheets as necessary and include the response letter from the Missouri Department of Conservation)</p>	
<p>5.2 Provide justification about how the multiple-discharger variance will not cause an impact to the federally-listed and/or stated-listed threatened or endangered species (designated or proposed) or their critical habitat that are known to be present at the point of discharge for your facility. (Please see Fact Sheet below titled; <u>Natural Heritage Review Report</u>. Attach additional sheets as necessary and include the response letter from the Missouri Department of Conservation)</p>	
<p>6. Alternative Effluent Control Analysis</p>	
<p>6.1 Provide an attached analysis of the alternative effluent controls examined, including but not limited to; discharge relocation alternative, land application or decentralization of the utility (or other no discharge options), and regionalization of the utility. (Please see Fact Sheet below titled; <u>Reasonable Alternatives Analysis</u>. Please include an aerial map outlining the current location of the outfall, the potential wastewater treatment facility (WWTF) effluent line, the potential WWTF discharge location and the mileage of line)</p>	
<p>7. Lagoon Design Profile</p>	
<p>7.1 Please refer to Attachment A. Complete Attachment A and submit with the completed application.</p>	
<p>8. CERTIFICATION</p>	
<p>FACILITY CONTACT</p>	<p>OFFICIAL TITLE</p>
<p>EMAIL ADDRESS</p>	<p>TELEPHONE NUMBER WITH AREA CODE</p>
<p>I certify under penalty of law that I have personally examined and am familiar with the information submitted in this application and all attachments and that based on my inquiry of those individuals immediately responsible for obtaining this information, I believe that the information is true, accurate and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine or imprisonment.</p>	
<p>OWNER OR AUTHORIZED REPRESENTATIVE</p>	<p>OFFICIAL TITLE</p>
<p>SIGNATURE</p>	<p>DATE SIGNED</p>

MULTIPLE-DISCHARGER VARIANCE APPLICATION

1. Application form is complete.
2. \$250.00 filing fee paid.
3. Submit the EPA spreadsheet; Uses and Variances – Evaluating Substantial and Widespread Economic and Social Impacts: Public Sector Entities. (4.2)
4. Submit the Natural Heritage Review Report from Missouri Department of Conservation (5)
5. Submit the Alternatives Analysis (6)
6. Submit Completed Attachment A found below (7)
7. This completed form and any attachments should be submitted electronically and by mail to:

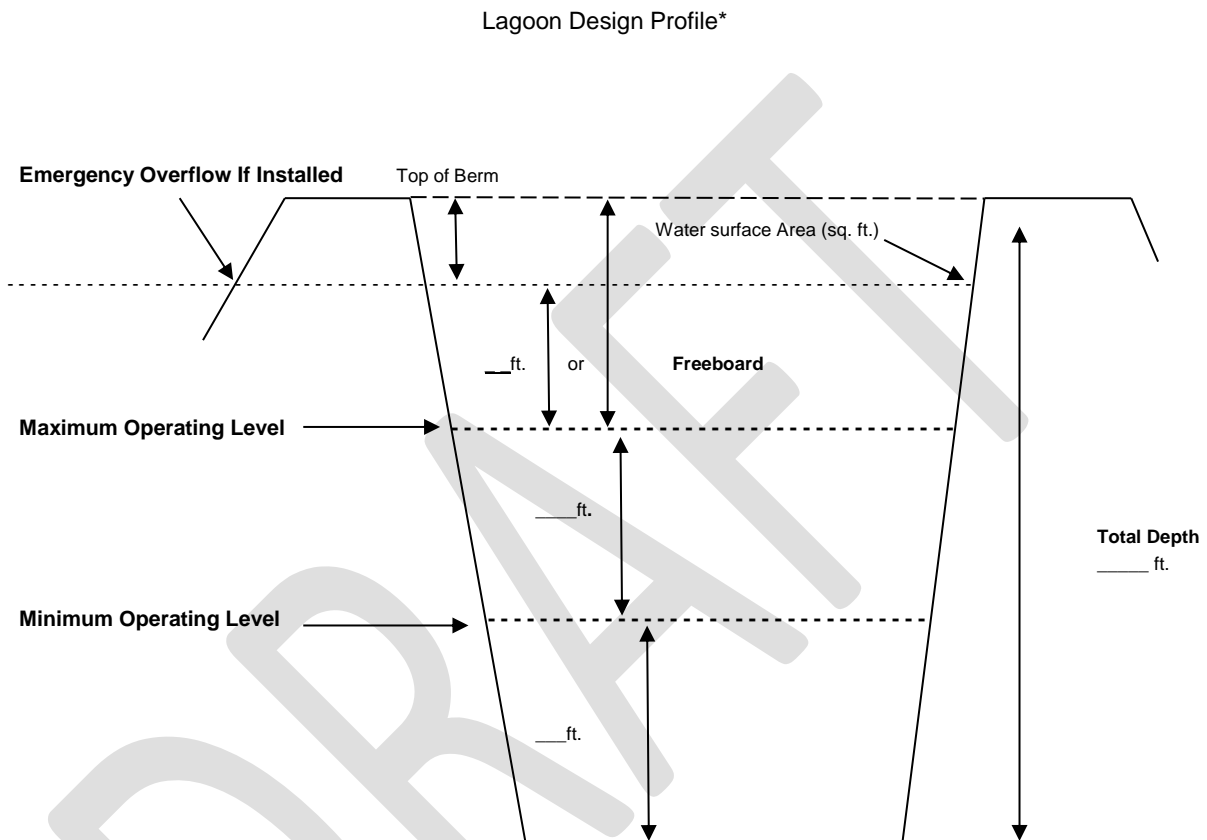
Department of Natural Resources
Water Protection Program
ATTN: MDV Team
P.O. Box 176
Jefferson City, MO 65102
WPSC.MultidischargerVariance@dnr.mo.gov

For additional guidance, see the following:

- <http://colowqforum.org/pdfs/standards-framework/01-2009/R7-State%20Variance%20Process.pdf>
- <http://water.epa.gov/scitech/swguidance/standards/upload/Discharger-specific-Variances-on-a-Broader-Scale-Developing-Credible-Rationales-for-Variances-that-Apply-to-Multiple-Dischargers-Frequently-Asked-Questions.pdf>
- http://water.epa.gov/learn/training/standardsacademy/upload/2007_11_15_standards_academy_basic_course_15-variances-11-15-07.pdf
- http://www.werf.org/i/c/DecentralizedCost/Decentralized_Cost.aspx
- For assistance in completing this form or the EPA form, please contact WPSC.MultidischargerVariance@dnr.mo.gov
- For more information, contact the department's Water Protection Program at 573-751-1300.

ATTACHMENT A

(To be included with the application)



DEFINITION OF TERMS (REFER TO THE PROFILE SKETCH ABOVE).

- A. Freeboard is depth from the water level to the point on the lagoon where a discharge from the cell would occur. This could be a constructed emergency spill way or the lowest point of the lagoon berm;
- B. Maximum Operating Level is at the top of outlet pipe or maximum weir setting.
- C. Minimum Operating Level is at the lowest outlet pipe or weir setting.
- D. Total Depth is from top of berm to bottom of basin berm to the bottom elevation.

* If the facility utilizes multiple cells, a separate lagoon design profile must be completed for each cell.

DRAFT

This page intentionally left blank

REASONABLE ALTERNATIVES ANALYSIS

Each municipality must consider all viable treatment options available to meet water quality standards for total ammonia nitrogen. The Cost Analysis for Compliance (CAFCOM) provided the estimated costs for a site specific wastewater lagoon to upgrade to a land application system and/or a mechanical treatment plant based on the design flow (in some cases, if appropriate, the average flow) and the number of connections to the facility. The estimated costs provided within the analysis are the total present worth, capital cost of the project, annual cost of operation and maintenance, and the estimated resulting cost per household (all definitions are provided below). Each CAFCOM uses software to estimate the cost for reconstruction of the treatment plant titled CAPDEWORKS (CapDet). CapDet estimates the complete reconstruction of the following treatment types depending on flow:

- Land application system – up to 150,000 gallons per day(gpd)
- Extended Aeration with a triangular basin – up to 10 million gallons per day(MGD)
- Sequencing Batch Reactor – flow range of 20,000 gpd to 10 MGD
- Oxidation Ditch – flow range of 20,000 gpd to 10 MGD
- Extended Aeration Package Plant – up to 50,000 gpd

All treatment technologies listed above are capable of meeting total ammonia nitrogen effluent limits of a 0.6 mg/L monthly average in the summer season and a 2.1 mg/L monthly average in the winter season. Based on the CAFCOM, the department has determined that the construction, installation and operation and maintenance of each of the treatment technologies listed above would cause a substantial and widespread economic and social impact for the residents of the municipality.

The alternatives analysis found below must be completed as part of the application process. The alternatives listed below are; regional treatment, discharge relocation, and decentralization. Each municipality should use the estimated costs provided by the department that most closely resemble how each alternative would be achieved for their site specific facility. Each applicant can then determine if one or more of the treatment scenarios below are reasonable alternatives in order to achieve water quality standards for total ammonia nitrogen.

REGIONAL TREATMENT

Regional treatment is considered a reasonable alternative if the authority receiving the wastewater has adequate surplus treatment capacity available to receive the additional wastewater while remaining within its current permitted design capacities for both flow and loading. That is, the wastewater addition occurs within the design capacity of the receiving treatment plant and a separate antidegradation review is not required. However, this option may or may not be an economically feasible option for your community. If this alternative treatment is not an option for your community, please include a statement based on one of the statements provided below when submitting your application for the multiple-discharger variance.

Choose the estimated costs closest to your situation from the spreadsheet below and include in the statement below. Please include a statement attached to your application based on one of the statements provided below:

If under 10 miles:

1. *The City of or Regional Treatment (insert closest City or regional treatment facility with a facility capable of receiving your design flow)'s treatment plant is the nearest facility that would be capable of accepting (insert your municipal name here) wastewater. The total present worth for pipes, manholes, pump stations and effluent forcemain to pump the community's entire wastewater flow were estimated to be (insert present worth costs here, \$X.XX) to pump WWTF effluent to (insert closest City with a facility capable of receiving your design flow). The total present worth costs assume a five percent interest rate over a 20 year term of loan and include the capital cost plus the annual operation and maintenance cost. To implement this alternative, the wastewater from (insert your municipal name here) would have to be pumped approximately (insert number of miles here) miles. The higher cost of this alternative is primarily due to the lengthy force main and associated pumping costs that would be required. The estimated cost per user per month for this alternative is (See example below and calculate the user cost and insert here, \$X.XX). The estimated residential user cost as a percent of the median household income (MHI) is calculated to be (See example below and calculate the percentage and insert here, X.X%). According to EPA's financial capability assessment guidance, "Combined Sewer Overflows: Guidance for Financial Capability Assessment and Schedule Development," a residential user cost as a percent of MHI of over two percent will result in a "high financial impact." Therefore, regionalization is not a feasible alternative for the (insert municipal name here) at this time. The inclusion of easement costs were not included in the estimated costs, however it is known the cost of easements can substantially raise the capital cost for the project. The estimates provided by the department anticipate the costs incurred from this alternative would result in a substantial and widespread economic and social impact for the residents of our community.*

If over 10 miles

2. *The City of or Regional Treatment (insert closest City or regional treatment facility capable of receiving your design flow)'s treatment plant is the nearest facility that would be capable of accepting the (insert your municipal name here)'s wastewater. To implement this alternative, the wastewater from (insert your municipal name here) would have to be pumped approximately (insert number of miles here) miles. The department has determined the total present worth associated with pipes, manholes, pump stations and effluent forcemain to pump the community's entire wastewater flow to a location farther than ten miles is a cost that will result in substantial and widespread economic and social impact. Regionalization of the wastewater treatment facility is not a feasible alternative at this time.*

DISCHARGE RELOCATION

A discharge relocation alternative should be considered by communities facing costly treatment upgrades. Please provide an attached aerial map to the multiple-discharger variance application outlining the current location of the outfall, the potential wastewater treatment facility (WWTF) effluent line, the potential WWTF discharge location and the mileage of effluent line it would take to get there. The alternative receiving stream will most likely need to be a class P (river) stream or a lake in order to receive higher effluent limits for Ammonia as N. If this alternative is not an option for your community, please include a statement based on one of the statements provided below when submitting your application for the multiple-discharger variance.

Choose the estimated costs closest to your situation from the spreadsheet below and include in the statement below. Please include a statement attached to your application based on one of the statements provided below:

If under 10 miles:

1. *The provided map outlines a potential routing strategy for the **(your facility's wastewater treatment facility name here)** alternate discharge location. This proposed alternative would convey WWTF effluent **(miles of necessary pipe)** miles to the **(new receiving stream)** through the addition of a new pipes, manholes, pump station(s) and effluent forcemain. A 10 percent contingency cost has been assumed for this project. However, due to the high level planning of this alternative and the potential unknown impacts regarding the proposed general alignment of the force main, the department has observed contingency costs up to 30 percent as appropriate for this project. The department has provided an estimate for the total present worth of this project to be **(insert present worth here, \$X.XX)**. The total present worth costs assume a five percent interest rate, 20 year term of loan, and includes capital costs plus annual costs for operation and maintenance. In order for **(insert municipal name here)** to pipe WWTF effluent to the closest alternative stream it could cost up to **(See user rate equation below and calculate the user cost and insert here, \$X.XX)** per residential user per month. The estimated residential user cost as a percent of the median household income (MHI) is calculated to be **(See user rate as a % of MHI equation below and calculate the percentage and insert here, X.X%)**. According to EPA's financial capability assessment guidance, "Combined Sewer Overflows: Guidance for Financial Capability Assessment and Schedule Development," a residential user cost as a percent of MHI of over two percent will result in a "high financial impact." Therefore, the relocation of the receiving stream is not a feasible alternative for the **(insert municipal name here)** at this time. The inclusion of easement costs were not included in the estimated costs, however it is known the cost of easements can substantially raise the capital cost for the project. Based on the cost estimates provided by the department, the anticipated project costs would result in a substantial and widespread economic and social impact for our community.*

If over 10 miles

2. *The provided map outlines a potential routing strategy for the **(your facility's wastewater treatment facility name here)** alternate discharge location. This proposed alternative would convey WWTF effluent **(miles of necessary pipe)** miles to the **(new receiving stream)** through the addition of a new pipes, manholes, pump station(s) and effluent forcemain. The department has determined the total present worth associated with pipes,*

manholes, pump stations and effluent forcemain to pump the community's entire wastewater flow to a location farther than ten miles is a cost that will result in substantial and widespread economic and social impact. An alternate discharge location of the wastewater treatment facility is not a feasible alternative at this time.

Estimated Present Worth Cost Matrix: to use as the cost estimate in the statements above.

Chose the flow closest to your facilities design flow (flow is listed as gallons per day) and pair with the distance (listed in miles). Please round up to the nearest design flow for the most accurate cost estimate. If your distance is greater than 10 miles it is assumed the projected cost associated with regionalization and/or diverting effluent to an alternative receiving stream will result in a substantial and widespread economic and social impact.

Present Worth	5% interest	20 year term									
		Distance (miles)									
Flow (gpd)	0.5	1	2	3	4	5	6	7	8	9	10
10,000	\$405,141	\$543,618	\$919,871	\$1,029,460	\$1,381,367	\$1,860,320	\$1,918,096	\$2,137,274	\$2,414,227	\$2,691,181	\$2,968,134
20,000	\$420,385	\$376,953	\$1,246,307	\$1,307,814	\$1,394,814	\$1,584,767	\$1,861,720	\$2,138,674	\$2,415,627	\$2,692,581	\$2,969,534
30,000	\$830,934	\$1,075,011	\$1,563,164	\$2,051,318	\$2,539,471	\$3,027,625	\$3,515,778	\$4,003,931	\$4,492,085	\$4,980,238	\$5,468,392
40,000	\$845,963	\$1,090,040	\$1,578,194	\$2,066,347	\$2,554,500	\$3,042,654	\$3,530,807	\$4,018,961	\$4,507,114	\$4,995,267	\$5,483,421
50,000	\$857,952	\$1,102,029	\$1,590,182	\$2,078,335	\$2,566,489	\$3,054,642	\$3,542,796	\$4,030,949	\$4,519,102	\$5,007,256	\$5,495,409
60,000	\$868,694	\$1,112,771	\$1,600,924	\$2,089,078	\$2,577,231	\$3,065,384	\$3,553,538	\$4,041,691	\$4,529,845	\$5,017,998	\$5,506,151
70,000	\$880,689	\$1,124,765	\$1,612,919	\$2,101,072	\$2,589,226	\$3,077,379	\$3,565,532	\$4,053,686	\$4,541,839	\$5,029,993	\$5,518,146
80,000	\$891,088	\$1,135,165	\$1,623,318	\$2,111,472	\$2,599,625	\$3,087,778	\$3,575,932	\$4,064,085	\$4,552,239	\$5,040,392	\$5,528,545
90,000	\$899,512	\$1,143,589	\$1,631,742	\$2,119,896	\$2,608,049	\$3,096,203	\$3,584,356	\$4,072,509	\$4,560,663	\$5,048,816	\$5,536,970
100,000	\$906,940	\$1,151,016	\$1,639,170	\$2,127,323	\$2,615,477	\$3,103,630	\$3,591,783	\$4,079,937	\$4,568,090	\$5,056,244	\$5,544,397
110,000	\$913,918	\$1,157,995	\$1,646,149	\$2,134,302	\$2,622,455	\$3,110,609	\$3,598,762	\$4,086,916	\$4,575,069	\$5,063,222	\$5,551,376
120,000	\$922,897	\$1,166,974	\$1,655,127	\$2,143,281	\$2,631,434	\$3,119,587	\$3,607,741	\$4,095,894	\$4,584,048	\$5,072,201	\$5,560,354
130,000	\$929,627	\$1,173,703	\$1,661,857	\$2,150,010	\$2,638,164	\$3,126,317	\$3,614,470	\$4,102,624	\$4,590,777	\$5,078,931	\$5,567,084
140,000	\$971,086	\$1,215,162	\$1,703,316	\$2,191,469	\$2,679,622	\$3,167,776	\$3,655,929	\$4,144,083	\$4,632,236	\$5,120,389	\$5,608,543
150,000	\$977,317	\$1,221,393	\$1,709,547	\$2,197,700	\$2,685,853	\$3,174,007	\$3,662,160	\$4,150,314	\$4,638,467	\$5,126,620	\$5,614,774

User Rate Equation: to use as the cost estimate in the statements above.

Estimated monthly residential user rate = Present Worth / 20 years / 12 months / # of connections to WWTF

Note: The # of connections is specific to your community and can be found on the Cost Analysis for Compliance written by the department.

User rate as a % of MHI Equation: to use as the cost estimate in the statements above.

Estimated monthly user rate as a % of MHI = [Estimated monthly residential user rate / (Median Household Income/12)] 100

Note 1: The estimated monthly residential user rate is calculated using the user rate equation

Note 2: The Median Household Income is specific to your community and can be found of the Cost Analysis for Compliance written by the department.

For your reference:

Assumptions made by the department to calculate the estimated costs:

- Construction Labor \$32 per hour
- Operator \$25 per hour
- 15 manholes per miles of pipe
- \$2.50 per foot for cleaning/maintenance (annual inspection for complete line)
- 10 year pump replacement
- 1 pump station for 0.01 and 0.02 flows, everything else 2 pump stations
- \$60 for 8 inch pipe (installation)
- \$20 for 6 inch pipe (used for 0.01 and 0.02 flows)
- 5% interest, 20 years
- 1 year construction period
- 10% design fee
- 10% contingency

Estimated Capital Cost Matrix:

Capital Cost											
	Distance (miles)										
Flow (gpd)	0.5	1	2	3	4	5	6	7	8	9	10
10,000	\$155,528	\$211,755	\$423,510	\$535,965	\$648,420	\$760,875	\$873,330	\$985,785	\$1,098,240	\$1,210,695	\$1,323,150
20,000	\$156,228	\$212,455	\$424,910	\$537,365	\$649,820	\$762,275	\$874,730	\$987,185	\$1,099,640	\$1,212,095	\$1,324,550
30,000	\$365,828	\$527,655	\$851,310	\$1,174,965	\$1,498,620	\$1,822,275	\$2,145,930	\$2,469,585	\$2,793,240	\$3,116,895	\$3,440,550
40,000	\$365,828	\$527,655	\$851,310	\$1,174,965	\$1,498,620	\$1,822,275	\$2,145,930	\$2,469,585	\$2,793,240	\$3,116,895	\$3,440,550
50,000	\$365,828	\$527,655	\$851,310	\$1,174,965	\$1,498,620	\$1,822,275	\$2,145,930	\$2,469,585	\$2,793,240	\$3,116,895	\$3,440,550
60,000	\$365,828	\$527,655	\$851,310	\$1,174,965	\$1,498,620	\$1,822,275	\$2,145,930	\$2,469,585	\$2,793,240	\$3,116,895	\$3,440,550
70,000	\$367,828	\$529,655	\$853,310	\$1,176,965	\$1,500,620	\$1,824,275	\$2,147,930	\$2,471,585	\$2,795,240	\$3,118,895	\$3,442,550
80,000	\$369,828	\$531,655	\$855,310	\$1,178,965	\$1,502,620	\$1,826,275	\$2,149,930	\$2,473,585	\$2,797,240	\$3,120,895	\$3,444,550
90,000	\$369,828	\$531,655	\$855,310	\$1,178,965	\$1,502,620	\$1,826,275	\$2,149,930	\$2,473,585	\$2,797,240	\$3,120,895	\$3,444,550
100,000	\$369,828	\$531,655	\$855,310	\$1,178,965	\$1,502,620	\$1,826,275	\$2,149,930	\$2,473,585	\$2,797,240	\$3,120,895	\$3,444,550
110,000	\$369,828	\$531,655	\$855,310	\$1,178,965	\$1,502,620	\$1,826,275	\$2,149,930	\$2,473,585	\$2,797,240	\$3,120,895	\$3,444,550
120,000	\$371,828	\$533,655	\$857,310	\$1,180,965	\$1,504,620	\$1,828,275	\$2,151,930	\$2,475,585	\$2,799,240	\$3,122,895	\$3,446,550
130,000	\$371,828	\$533,655	\$857,310	\$1,180,965	\$1,504,620	\$1,828,275	\$2,151,930	\$2,475,585	\$2,799,240	\$3,122,895	\$3,446,550
140,000	\$399,828	\$561,655	\$885,310	\$1,208,965	\$1,532,620	\$1,856,275	\$2,179,930	\$2,503,585	\$2,827,240	\$3,150,895	\$3,474,550
150,000	\$399,828	\$561,655	\$885,310	\$1,208,965	\$1,532,620	\$1,856,275	\$2,179,930	\$2,503,585	\$2,827,240	\$3,150,895	\$3,474,550

Estimated Annual Operation and Maintenance:

Annual O&M											
Distance (miles)											
Flow (gpd)	0.5	1	2	3	4	5	6	7	8	9	10
10,000	\$20,030	\$26,630	\$39,830	\$39,600	\$251,400	\$92,860	\$79,200	\$92,400	\$105,600	\$118,800	\$132,000
20,000	\$21,197	\$13,200	\$226,400	\$68,794	\$52,800	\$66,000	\$79,200	\$92,400	\$105,600	\$118,800	\$132,000
30,000	\$37,322	\$43,922	\$57,122	\$70,322	\$83,522	\$96,722	\$109,922	\$123,122	\$136,322	\$149,522	\$162,722
40,000	\$38,528	\$45,128	\$58,328	\$71,528	\$84,728	\$97,928	\$111,128	\$124,328	\$137,528	\$150,728	\$163,928
50,000	\$39,490	\$46,090	\$59,290	\$72,490	\$85,690	\$98,890	\$112,090	\$125,290	\$138,490	\$151,690	\$164,890
60,000	\$40,352	\$46,952	\$60,152	\$73,352	\$86,552	\$99,752	\$112,952	\$126,152	\$139,352	\$152,552	\$165,752
70,000	\$41,154	\$47,754	\$60,954	\$74,154	\$87,354	\$100,554	\$113,754	\$126,954	\$140,154	\$153,354	\$166,554
80,000	\$41,828	\$48,428	\$61,628	\$74,828	\$88,028	\$101,228	\$114,428	\$127,628	\$140,828	\$154,028	\$167,228
90,000	\$42,504	\$49,104	\$62,304	\$75,504	\$88,704	\$101,904	\$115,104	\$128,304	\$141,504	\$154,704	\$167,904
100,000	\$43,100	\$49,700	\$62,900	\$76,100	\$89,300	\$102,500	\$115,700	\$128,900	\$142,100	\$155,300	\$168,500
110,000	\$43,660	\$50,260	\$63,460	\$76,660	\$89,860	\$103,060	\$116,260	\$129,460	\$142,660	\$155,860	\$169,060
120,000	\$44,220	\$50,820	\$64,020	\$77,220	\$90,420	\$103,620	\$116,820	\$130,020	\$143,220	\$156,420	\$169,620
130,000	\$44,760	\$51,360	\$64,560	\$77,760	\$90,960	\$104,160	\$117,360	\$130,560	\$143,760	\$156,960	\$170,160
140,000	\$45,840	\$52,440	\$65,640	\$78,840	\$92,040	\$105,240	\$118,440	\$131,640	\$144,840	\$158,040	\$171,240
150,000	\$46,340	\$52,940	\$66,140	\$79,340	\$92,540	\$105,740	\$118,940	\$132,140	\$145,340	\$158,540	\$171,740

DECENTRALIZATION

This section examines the approximate cost of subsurface soil dispersal (absorption) systems for a small community's domestic wastewater system. This is not intended to be an all-inclusive evaluation of the cost of these systems in the State of Missouri nor does the department endorse one type of dispersal system over another.

The primary costs discussed within this section were gathered from the Water Environment Research Foundation (WERF) Fact Sheets (D1, D2 & D3) for Decentralized Wastewater Systems, Performance & Cost of Decentralized Unit Processes, Dispersal Series. Copies of those Fact Sheets can be found at:

http://www.werf.org/i/c/DecentralizedCost/Decentralized_Cost.aspx. Costs given in the WERF Fact Sheets reflect 2009 estimate dollars. The Cost Estimation Tool developed by WERF was not used as part of the cost estimations shown below; however, the tool listed above can be used to calculate what the primary estimated cost to decentralize the sewer utility for your specific community. The following documentation provides several examples of the estimated cost to install a variety of systems including; individual onsite wastewater treatment systems, large scale subsurface soil dispersal systems, as well as the cost of cluster with individual onsite wastewater treatment systems.

The subsurface soil dispersal systems described below are for domestic wastewater (sewage) only as defined in RSMo 701.025(12) Definitions "sewage" or "domestic sewage" "...Human excreta and wastewater, including bath and toilet waste, residential laundry waste, residential kitchen waste and other similar waste from household or establishment appurtenances."

INDIVIDUAL ONSITE WASTEWATER TREATMENT (SEPTIC) SYSTEMS:

While the use of individual onsite wastewater treatment systems (OWTS) can be considered as an option, it should be noted that a detailed thorough systematic evaluation of each lot must be conducted by a qualified individual to ensure all of the soil and site limitations are addressed in the specific design and installation. It should also be noted that because of the complexity of the soils/landscape model throughout the state, a one-size-fits-all design is not a practical solution whenever using individual onsite wastewater treatment systems within any community.

The methodology used within 10 CSR 20-6.030 Disposal of Wastewater in Residential Housing Developments for determining minimum lots size within a residential housing (subdivision) development can be used as a guide when initially investigating if OWTS are an alternative.

Please note that 10 CSR 20-6.030 (1)(D) states that "For residential housing developments with lots less than forty thousand (40,000) square feet, (0.92 acres) only centralized sewage collection and treatment are acceptable..." In those cases where the lots are less than 0.92 acres or have limited amount of available space with suitable soils/landscapes, a centralized or cluster system should be considered.

If individual OWTS are chosen as the method of wastewater treatment, a continuing authority (responsible management entity) must be established to ensure they are a sustainable solution. Construction permits, installation and operation of the OWTS will require multiple agency cooperation to ensure the process proceeds in a timely manner. To understand what regulatory

agencies may be involved in permitting OSTs, a copy of the department's Fact Sheet, "Who Regulates Domestic Wastewater in Missouri?" can be found at the following link:

<http://dnr.mo.gov/pubs/pub1296.pdf>

The costs in Table 1 (below) should be used for cost estimation purposes only. As described within the WERF Fact Sheets (D1, D2 & D3) the costs are for the materials, installation and maintenance of the dispersal system only. They do not include the cost of installation, maintenance, total life cycle of the septic tanks(s), advanced treatment components or disinfection devices. Cost presumed to include 20 % overhead and profit for contractor and there are no sales taxes on materials. Engineering fees and other professional services are not included. The actual costs can vary significantly depending upon site conditions and local economic factors. Costs given presented in the WERF Fact Sheets reflect 2009 dollars.

TABLE 1
Single Family Dispersal System Cost Estimates

FACTORS	Gravity Distribution Fact Sheet D1	Low Pressure Pipe Fact Sheet D2	Drip Distribution Fact Sheet D3
Wastewater Flows	450 gallons/day (gpd)	450 gpd	450 gpd
Topography	Relatively Flat	Relatively Flat	Relatively Flat
Application Rate	0.4 gpd/sq. ft.	0.2 gpd/sq. ft.	0.3 gpd
Soil Treatment Area	1,125 sq. ft.*	2,250 sq. ft.*	1,500 sq. ft.*
Lateral Line	562 linear feet*	1,125 linear feet*	750 linear feet*
Material & Installation	\$4,600 - \$6,900	\$9,000 - \$14,000	\$8,000 - \$12,000
Annual O&M	\$200 - \$400	\$540 - \$800	\$500 - \$740

NOTE: It is extremely rare that a drip distribution system within the state is designed with an application rate of 0.3 gpd/sq. ft. a more common application rate is 0.15 gpd per sq. ft.

The costs in Table 2 (below) should be used for cost estimation purposes only. The costs are presumed to include all components for an OWTS serving a single family home on an individual lot and were compiled as part of a cursory survey of professionals within the onsite wastewater industry within the state. No specific documentation was collected as part of that survey. The actual costs can vary significantly depending upon site conditions and local economic factors. Engineering fees and other professional services are not included. A single family residence in the state is designed at 120 gpd/bedroom*, averaging three (3) bedrooms.

TABLE 2
Individual Onsite Wastewater Treatment System Cost Estimates

FACTORS	Gravity Distribution	Low Pressure Pipe	Drip Distribution
Wastewater Flows	360 gpd	360 gpd	360 gpd
Application Rate	0.4 gpd/sq. ft.	0.2 gpd/sq. ft.	0.15 gpd
Soil Treatment Area	900 sq. ft.*	1,800 sq. ft.*	2,400 sq. ft.*
Lateral Line	450 linear feet*	900 linear feet*	1,200 linear feet*
Material & Installation	\$5,000 - \$8,000	\$9,000 - \$20,000	\$15,000 - \$25,000

LARGE SCALE SUBSURFACE SOIL DISPERSAL SYSTEMS:

The cost listed in Tables 3, 4 and 5 (below) should be used for cost estimation purposes only. As described within the WERF Fact Sheets (D1, D2 & D3), the costs reflect only those associated with the dispersal system itself and do not include cost for any part of the wastewater treatment prior to the dispersal system. The estimated costs below do not include the cost of engineering, other professional fees, the cost to close the current wastewater treatment facility or the cost of land acquisition. Cost includes 20% for overhead and profit for contractor. The actual costs can vary significantly depending upon site conditions and local economic factors. Costs given within the WERF Fact Sheets reflect 2009 dollars.

TABLE 3
5,000 Gallons per Day or 20 Home Cost Estimates

FACTORS	Gravity Distribution Fact Sheet D1	Low Pressure Pipe Fact Sheet D2	Drip Distribution Fact Sheet D3
Topography	Relatively Flat	Relatively Flat	Relatively Flat
Application Rate	0.4 gpd/sq. ft.	0.2 gpd/sq. ft.	0.3 gpd
Soil Treatment Area	12,500 sq. ft.*	25,000 sq. ft.*	16,666 sq. ft.*
Lateral Line	6,250 linear feet*	12,500 linear feet*	8,333 linear feet*
Material & Installation	\$54,000 - \$81,000	\$84,000 - \$127,000	\$37,000 - \$56,000
Annual O&M	\$2,300 - \$3,400	\$4,900 - \$7,400	\$3,000 - \$5,000

TABLE 4
10,000 Gallons per Day or 40 Home Cost Estimates

FACTORS	Gravity Distribution Fact Sheet D1	Low Pressure Pipe Fact Sheet D2	Drip Distribution Fact Sheet D3
Topography	Relatively Flat	Relatively Flat	Relatively Flat
Application Rate	0.4 gpd/sq. ft.	0.2 gpd/sq. ft.	0.3 gpd
Soil Treatment Area	25,000 sq. ft.*	50,000 sq. ft. or 1.1 ac*	33,333 sq. ft.*
Lateral Line	12,500 linear feet*	25,000 linear feet*	16,666 linear feet*
Material & Installation	\$105,000 - \$158,000	\$184,000 - \$275,000	\$85,000 - \$127,000
Annual O&M	\$4,400 - \$6,600	\$10,000 - \$15,000	\$6,900 - \$10,000

TABLE 5
50,000 Gallons per Day or 200 Home Cost Estimates

FACTORS	Gravity Distribution Fact Sheet D1	Low Pressure Pipe Fact Sheet D2	Drip Distribution Fact Sheet D3
Topography	Relatively Flat	Relatively Flat	Relatively Flat
Application Rate	0.4 gpd/sq. ft.	0.2 gpd/sq. ft.	0.3 gpd
Soil Treatment Area	2.9 acres*	5.7 acres*	3.8 acres*
Lateral Line	62,500 linear feet*	125,000 linear feet*	83,333 linear feet*
Material &	\$517,000 - \$776,000	\$1,365,000 -	\$329,000 - \$494,000

Installation		\$2,047,000	
Annual O&M	\$21,000 - \$31,000	\$66,000 – \$98,000	\$31,000 – \$47,000

NOTE: There are no known gravity distribution systems within the state of the size represented in Tables 3, 4, or 5 (above). It is also extremely rare that a drip distribution system within the state is designed with an application rate of 0.3 gpd per sq. ft. A more common application rate is 0.15 gpd per sq. ft.

The estimated costs listed in Table 6 (below) should be used for cost estimations only and were compiled from a preliminary engineering report submitted to the department. The costs reflect only those associated with the dispersal system itself and do not include cost for any part of the wastewater treatment prior to the dispersal system. The estimated costs below do not include the cost of engineering, other professional fees, the cost to close the current wastewater treatment facility or the cost of land acquisition. Costs are presumed to include overhead and profit for contractor.

TABLE 6
Actual Cost Submitted within a Preliminary Engineering Report

FACTORS	Drip Distribution
Wastewater Flows	49,000 gpd
Population	490 persons
Topography	0 to 8 percent
Application Rate	0.15 gpd
Soil Treatment Area	7.5 acres*
Lateral Line	164,000 linear feet*
Material & Installation	\$795,000

COMPARITIVE COST:

Individual Onsite Wastewater Treatment Systems

Using only the estimated cost as presented in the WERF Fact Sheets (D1, D2 & D3), using 200 homes and/or a maximum daily flow of 50,000 gallons per day, the following scenarios can be used for comparison purposes only. Please remember the cost discussed below reflect only those of the dispersal system only. They do not include installation, maintenance and total lifecycle costs for septic tank(s), advanced treatment components, cost to close the current wastewater treatment system and disinfection devices.

As stated above there is not a one-size-fits-all system for individual OWTS for any community within the state for a number of reasons, ranging from limited space, suitable soils, to landscapes. But if they are able to be installed on all of the individual lots, the cost presented in Table 7 can be used for comparison purposes only. The actual costs can vary significantly depending upon site conditions and local economic factors.

TABLE 7
Single Family Dispersal Systems Cost Estimates

TYPE of Individual OWTS	Total Number Homes & Cost/Home	APPROXIMATE COSTS
Gravity Distribution	40 homes @ \$6,900 each	\$276,000.00
Low Pressure Pipe	110 homes @ \$14,000 each	\$1,540,000.00
Drip Distribution	150 homes @ \$12,000 each	\$1,800,000.00
TOTAL		\$3,616,000.00

Cluster with Individual Onsite Wastewater Treatment System

Cluster systems can also be considered as an alternative in situations where individual onsite systems will not work by themselves, but where combinations of those systems are proposed to replace an existing centralized collection and treatment system. The cost in Table 8 is one scenario and should be used only for comparison purposes. The actual costs can vary significantly depending upon site conditions and local economic factors. As previously stated, the costs reflect those for the dispersal system only and do not include cost estimates for installation, maintenance and total lifecycle costs for septic tank(s), advanced treatment components, or cost to close the current wastewater treatment system and disinfection devices.

TABLE 8
Cluster and Single Family Dispersal Systems Cost Estimates

TYPE of DISPERSAL SYSTEM	Number of Systems	Gallons per Day/System	Approximate Costs
Single Family using Gravity Distribution	5 @ \$6,900.00 each		\$34,500.00
Single Family using Low Pressure Pipe	15 @ \$14,000.00 each		\$210,000.00
Single Family using Drip Distribution	20 @ \$12,000.00 each		\$240,000.00
Cluster using Drip Dispersal	2 @ \$56,000.00 each	5,000 gpd	\$112,000.00
Cluster using Drip Dispersal	3 @ \$127,000.00 each	10,000 gpd	\$381,000.00
TOTAL			\$977,500.00

CENTRALIZED:

When estimating the cost of converting an existing centralized domestic wastewater collection and treatment system from a point discharge to a subsurface soil dispersal system, refer to Table 3, 4 or 5 (above) for the different systems and daily wastewater flow they service.

CURRENT WASTEWATER SYSTEM CLOSURES:

1. **Lagoon:** If the municipality chooses to proceed with decentralizing the wastewater treatment utility, the current lagoon or sand filter will need to be properly closed according to Standard Conditions Part III the current NPDES operating permit. The department has estimated the cost of a lagoon closure to be approximately \$30,000. The

cost of sludge removal varies, depending on the total amount of sludge in the lagoon; however, each municipality can use the following equation to estimate the cost of sludge removal.

Using documented costs of:

- Dredging and disposal: \$750.00 per dry ton
- Mobilization and set up: \$25,000 flat rate

Estimated Cost for Sludge Removal = (Dry tons of sludge per year x Life span of lagoon in years x \$750 per dry ton of sludge) + \$25,000 mobilization fee.

2. **Media Filters:** The department has estimated the cost to close a media filter to be a total of approximately \$30,000. The municipality is required to ensure that their current lagoon or media filter is properly terminated which will be a substantial added cost to cost estimates shown above.

ESTIMATED COST OF LAND ACQUISITION (BY REGION):

In some cases, the municipality will be required to acquire land in order to decentralize the current sewer utility. The department estimated the cost of land by separating the State into four regions by highways. The estimated cost of land per acre is shown below.

- North of Highway 36: \$6,588 per acre
- Between Highway 36 and Highway 50: \$6,316 per acre
- Between Highway 50 and Highway 60: \$6,208 per acre
- South of Highway 60: \$7,572 per acre

The cost to purchase additional land could be a substantial increase to the estimated costs of the treatment alternatives listed above.

* Calculations made using standards set forth by the Missouri Clean Water Law (Chapter 644) and its regulations along with those set forth by RSMo 701.025 through 701.059 and the regulations promulgated under it.

Use the Cost Tool provided on

http://www.werf.org/i/c/DecentralizedCost/Decentralized_Cost.aspx, or a cost estimate from the examples provided above to determine what an estimated cost would be for your municipality to decentralize. Please include the estimated cost to properly close your current wastewater treatment system. If it is determined that the cost to decentralize the current sewer utility will result in a substantial and widespread social and economic impact, please include a statement attached to your application based on the statement provided below:

1. The City of (insert your municipal name here) has considered the cost to decentralize the current sewer utility. Based on the estimates provided by the department, the city has determined the cost to properly close the current (choose one: media filter / lagoon) to be (include the cost to close current facility plus the cost to remove sludge/pump out septic tank, \$X.XX). With the city's current flow of (Insert design flow here XXXXX gpd) the estimated primary cost to install the onsite wastewater treatment system is (\$x.xx , use an example shown above or the cost tool provided by WERF at: http://www.werf.org/i/c/DecentralizedCost/Decentralized_Cost.aspx). This cost would result in residential user rates of (See user rate equation below and calculate the user cost and insert here, \$X.XX.) per residential user per month. The estimated residential user cost as a percent of the median household income (MHI) is calculated to be (See user rate as a % of MHI equation below and calculate the percentage and insert here, X.X%). The city will also need to acquire land to be able to install the onsite wastewater treatment systems. The price of land has not been incorporated into these equations; however, the acquisition of land will substantially raise the estimated cost per residential user provided above. According to EPA's financial capability assessment guidance, "Combined Sewer Overflows: Guidance for Financial Capability Assessment and Schedule Development," a residential user cost as a percent of MHI of over two percent will result in a "high financial impact." Therefore, decentralization of the sewer utility is not a feasible alternative for the (insert municipal name here) at this time. The estimates provided by the department anticipate the costs incurred from this alternative would result in a substantial and widespread economic and social impact for the residents of our community.

User Rate Equation:

Estimated monthly residential user rate = Present Worth / 20 years / 12 months / # of connections to WWTF

Note: The # of connections is specific to your community and can be found on the Cost Analysis for Compliance written by the department.

User rate as a % of MHI Equation:

Estimated monthly user rate as a % of MHI = [Estimated monthly residential user rate / (Median Household Income/12)] 100

Note 1: The estimated monthly residential user rate is calculated using the user rate equation

Note 2: The Median Household Income is specific to your community and can be found of the Cost Analysis for Compliance written by the department.

Sludge Removal Equation:

Estimated Cost for Sludge Removal = (Dry tons of sludge per year x Life span of lagoon in years x \$750 per dry ton of sludge) + \$25,000 mobilization fee.

Definitions:

Present Worth: Present Worth includes a five percent interest rate to construct and perform annual operation and maintenance of the new treatment plant over the term of the loan.

Capital Cost of Project: Capital Cost includes project costs, design, inspection and contingency costs.

Annual cost of Operation and Maintenance: Operation and maintenance cost includes operations, maintenance, materials, chemical and electrical costs for the facility on an annual basis. It includes items that are expected to replace during operations, such as pumps. Operation and maintenance is estimated between 15% and 45% of the user cost.

Estimated resulting user cost per household: The Estimated User Cost is composed of two factors, Operation & Maintenance (O&M), and Debt Retirement Costs.

This page intentionally left blank

NATURAL HERITAGE REVIEW REPORT

Each applicant is required to provide justification using the Natural Heritage Review Report (NHRR) detailing how the Multiple-Discharger Variance will not cause an impact to federally-listed and/or state-listed threatened or endangered species (designated or proposed) or their critical habitat that are known to be present at the point of discharge. The NHRR provides information about that species known to occur in the specified area by the Missouri Department of Conservation (MDC). The initial inquiry should be to be mailed to MDC at:

MDC Natural Heritage Review
Resource Science Division
P.O. Box 180
Jefferson City, MO 65102-0180
(Phone 573-522-4115 ext. 3182)
www.mdc.mo.gov

The NHRR inquiry request should include the following;

- Name, phone number and email the MDC reviewer can contact with questions about the location or project type (wastewater treatment facility contact).
- Statement that requestor wants a “Natural Heritage Review Report” for the project.
- The type of project. For example, “domestic discharge and permitting variance.”
- Location: County; Township/Range/Section; Latitude/Longitude in decimal degrees.
- Maps: (1) Location at a scale that the project site can be found with roads/orienting features labeled; (2) Site design showing the project footprint.
- Name of affected water body. (receiving stream)

If a state-listed endangered species is found, the report typically provides best management practices (BMPs) for avoiding and reducing impacts on the species. If a federally-listed endangered species is known to MDC in the vicinity of the project, the United States Environmental Protection Agency (USEPA) will contact the U.S. Fish and Wildlife Service (USFWS) during their review process of the multiple-discharger variance.

Please follow the letter template provided below to complete the inquiry request for the Natural Heritage Review Report and mail to the MDC address provided above.

To Whom It May Concern;

*The City of **(Include your city or village name here)** is requesting a Natural Heritage Review Report (NHRR) be completed at our wastewater treatment plant outfall. The type of project being completed is for a variance of the water quality standards for Total Ammonia Nitrogen at the point of discharge from the city's domestic wastewater treatment facility. The location of the outfall is **(include Township/Range/Section and the Latitude/Longitude in decimal degrees of the outfall)**. The facility is currently permitted to discharge to **(name of receiving stream)**. Please see the attached map for an aerial view of the location.*

*If you have any questions concerning this inquiry for the NHRR, please do not hesitate to contact **(facility contact name here)** by phone at **(contact's phone number)** or by email at **(contact's email address)**.*

Sincerely,

This page intentionally left blank

Highest Attainable Demonstration for Recirculating Media Filters

Intent

Recirculating Media Filters (RMFs) are an important wastewater treatment technology in terms of cost effectiveness and operational viability, especially in southern and central Missouri. Recirculating Media Filters that are properly designed, operated, and maintained can be protective of water quality where instream assimilative capacity exists. The intent of this memo is to establish a highest attainable effluent level for ammonia to support the multiple-discharge variance request for disadvantaged communities that will experience a substantial and widespread economic and social burden with respect to costs associated with compliance with ammonia water quality standards. On the other hand, many of the existing neglected systems can pose a threat to surface water. Therefore, it is imperative that the highest attainable effluent conditions be protective of existing water quality.

Statement of Issue

Small communities have a small rate base and lack the funds to build and maintain advanced treatment system, such as activated sludge, to achieve the current and EPA recommended ammonia water quality criteria within the time period afforded by a compliance schedule. In southern and central Missouri, RMFs have been built to meet to remove biochemical oxygen demand and total suspended solids.

Highest Attainable Determination Approach

The department's approach utilizes that RMFs provide a reliable, low cost and relatively low maintenance treatment for municipalities. Although the basic design of RMFs has not changed for the last 30 years, the department will also examine some of the innovations and improvements in light of the economic considerations. This document will allow communities that are struggling financially to make the most effective improvements to their wastewater treatment facilities to operate at the highest attainable effluent conditions during the period of the multiple-discharge variance. It is expected that these treatment improvements will not result in degradation to existing water quality, if any, it will improve water quality by allowing disadvantaged communities time to maintain their existing infrastructure at a level that produces the highest attainable effluent conditions, while financially preparing for future upgrades or other alternatives available at that time. The determination will not address streams that are on the 303(d) list or where a TMDL is developed.

Discussion on Recirculating Media Filters

For RMFs, the use of media filtration in this context employs a combination of physical, chemical and biological processes to produce effluent that may meet requirements for discharge to surface waters, depending on receiving water criteria. The "media" can be any of a number of physical structures whose sole purpose is to provide a surface to support biological growth. Commonly used media includes rock, gravel, sand of various sizes, and textile media. The category of treatment referred to as media filtration includes a number of variations on the process. They can be broken down into subcategories based on how many passes through the filter the wastewater makes, whether the filter surface is open to the air or buried, and the relative size and type of the media (sand, gravel, textile or other).

In all cases, pretreatment of the wastewater to reduce the BOD and suspended solids content of raw sewage is required. Once settling is accomplished, the pre-treated wastewater is applied to the filter surface in small doses, to alternately load and rest the media. As wastewater percolates down through the filter bed, it comes into contact with the bacterial film growing on the media. The media should have a high surface area to volume ratio, large enough voids to allow air filtration and to minimize fouling, UV resistance if exposed to sunlight, low solubility in water and acidic conditions.

The filtrate is contained by an impermeable liner, and collected in an underdrain. The underdrain pipe directs the filtrate to a flow splitting structure, in which a portion of the flow can be diverted back to the recirculation tank for additional treatment, with the rest discharged as effluent. Where total nitrogen removal is desired, recirculation back through the settling tanks provides contact between the nitrate-laden filtrate and carbon-bearing influent in the presence of bacteria. Figure 1 below provides schematic of how RMFs are normally designed. Figure 2 below is how flows go from influent back through the recirculation tank and then to the outfall; the scenario presented below is considered a 4:1 ratio.

Figure 1: General RMF Schematic

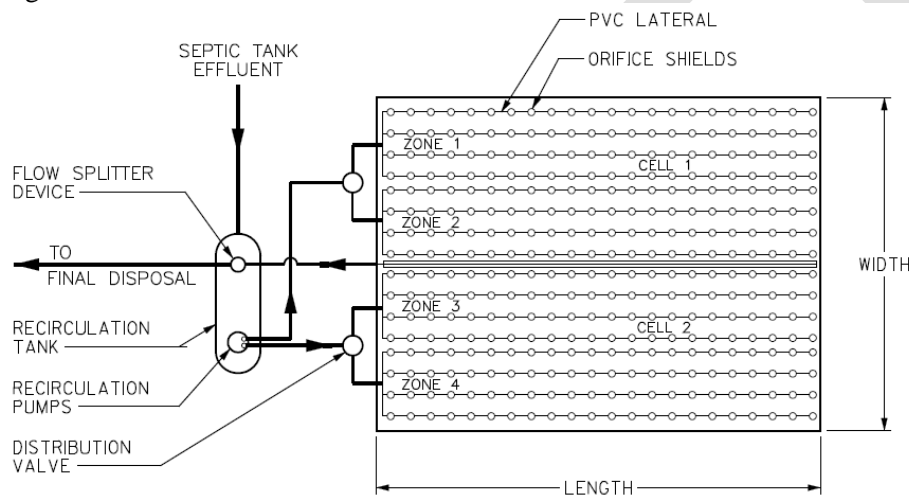
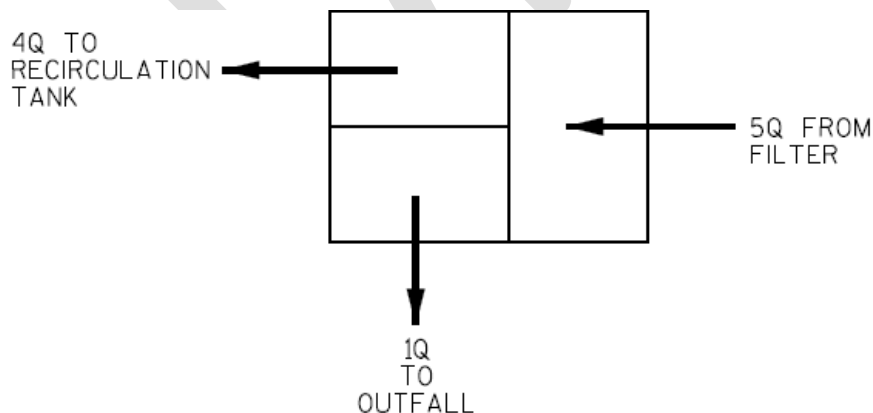


Figure 2: Recirculation Ratio



Recirculating Media Filter Design Guide Sizing

RMFs produce a high quality effluent with approximately 85% to 95% Biochemical Oxygen Demand and Total Suspended Solids removal. In addition, almost complete nitrification is achieved. Denitrification also has been shown to occur in RMFs. Depending on modifications in design and operation, 50% or more of applied nitrogen can be removed. The performance of a RMF system depends on the type and biodegradability of the wastewater, the environmental conditions within the filter, and the design characteristics of the filter. Temperature affects the rate of microbial growth, chemical reactions, and other factors that affect the stabilization of wastewater within the RMFs. Other parameters that affect the performance and design of RMFs are the degree of wastewater pretreatment, the media size, media depth, hydraulic loading rate, organic loading rate, and dosing techniques and frequency.

10 CSR 20-8.020(13)(C) is the department's small system design guide for sand filters. It was last updated in 1979. The design guide focuses on the removal of BOD and TSS, not ammonia. The department is currently in the process of updating the design guides to include ammonia removal as a parameter. While the department has not updated their regulations, EPA released a design memo in 1999 on Recirculating Sand Filters, which included discussion of Ammonia removal. Besides EPA's 1999 memo, the Iowa Department of Natural Resources updated their design criteria for RMFs in 2007, which provides the basis of the design parameters listed in Table 1. The existing facilities should be designed to meet these criteria.

Table 1: Design Parameters and Criteria for RMFs

Parameter	Criteria
Hydraulic Loading	≤ 5.0 gpd/ft ²
Organic Loading	≤ 0.002 lb/ft ² /day
Alkalinity	7.1 grams CaCO ₃ per 1 gram NH ₄ -N
Recirculation Ratio	$\geq 3:1$
Recirculation Tank Capacity	peak design flow
Dosing Time On	2-3 minutes
Dosing Frequency	minimum 48 doses per day
Volume per orifice	1-2 gallons per orifice per dose

Technical Review

Ammonia concentrations from the discharge monitoring report (DMR) for RMFs with design flows of less than 150,000 gallon per day were evaluated. A wide range of ammonia concentrations were observed, with the lowest effluent concentration being 0 milligrams per liter (mg/L) and the highest being 53.5 mg/L. Many of the facilities currently have monitoring only or just received effluent limits; however the data shows that on average, the facilities are operating near the current water quality standard ammonia effluent limits of 1.4 mg/L for summer and 2.9 mg/L for winter. The data shows that while many communities are meeting the current ammonia limit, there are several that are not. These communities are facing new water quality requirements for ammonia that were not factored into design specifications when many of the existing filters were constructed.

In review of the facilities, three communities had higher reported ammonia concentrations that averaged above the water quality standards: PCRSD Red Rock, Diggins, and Allendale. All three showed volatility in the reported concentrations, without further analysis into the operations, maintenances, and events at the facilities, it is hard to determine why the data from these facilities is high.

Development of Benchmark Limits

The department reviewed thirty-six recirculating media filters under 150,000 gallons per day. The only data points removed from the data set were those dates when information was not received, marked in

MoCWIS with “DMR Non-receipt,” “Conditional Monitoring Not Required,” “Frozen Conditions,” “Operation Shutdown,” and “No Discharge.” While there are more recirculating media filters than what the department evaluated, the review was limited to publicly owned facilities that are required to perform operational monitoring in accordance with 10 CSR 20-9.010.

The majority of the RMFs had quarterly monitoring for a period of less than five years, providing small data sets for each facility. The information in Table 2 is the statistical analysis of all the data from the 36 facilities used. In Appendix A, a sampling of the facilities with more than ten data points was plotted. The data was divided into the seasonal review, the summer season is April 1-September 30 and the winter season is October 1-March 31.

Table 2: Summary of Publicly Owned Wastewater Treatment Plant Ammonia Effluent Discharges

	Summer (mg/L)	Winter (mg/L)
Maximum	53.3	40.5
Average	4.60	5.0
95 th percentile	22	19.2
90 th percentile	12	14
80 th percentile	6.0	8.2
75 th percentile	4.5	6.6
50 th percentile	1.3	1.8
25 th percentile	0.3	0.4

Operational Measures

For RMFs to continue operating at a high level of treatment, operation and maintenance must occur on a regularly scheduled basis. Under the original construction permit, an Operations and Maintenance Manual was developed with the minimum requirements. The operations and maintenance manual must be reevaluated and updated as items at the facility change, including failure of a component, replacement of pumps, and on a minimum of every five years. To keep the facility operating well, the plant must not be hydraulically or organically overloaded. If it is not hydraulically or organically overloaded, the operations and maintenance activities listed below are ways to maintain the highest level of performance or possibly improve performance:

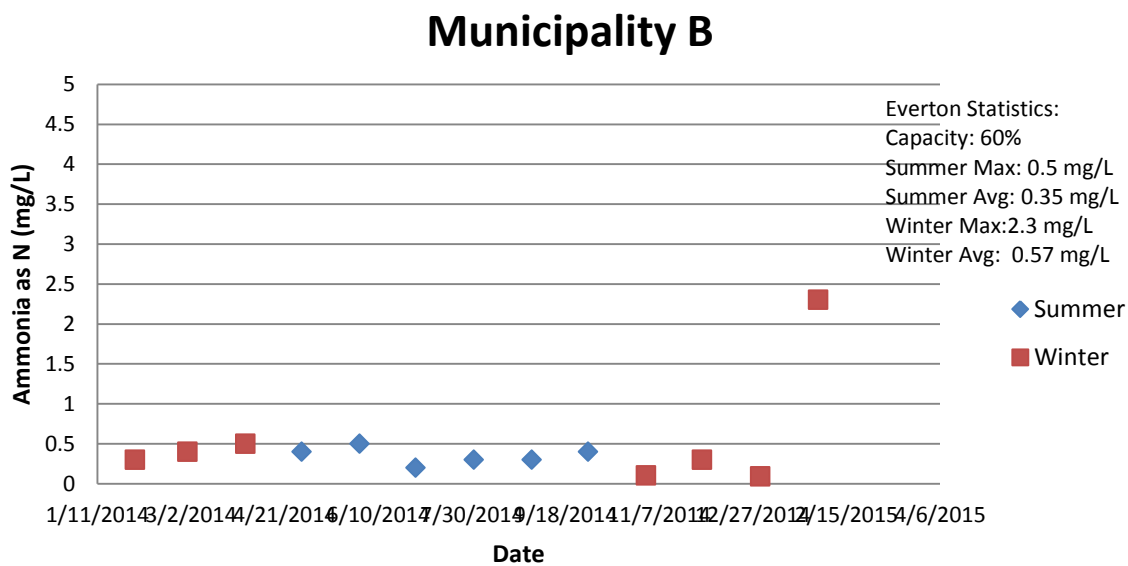
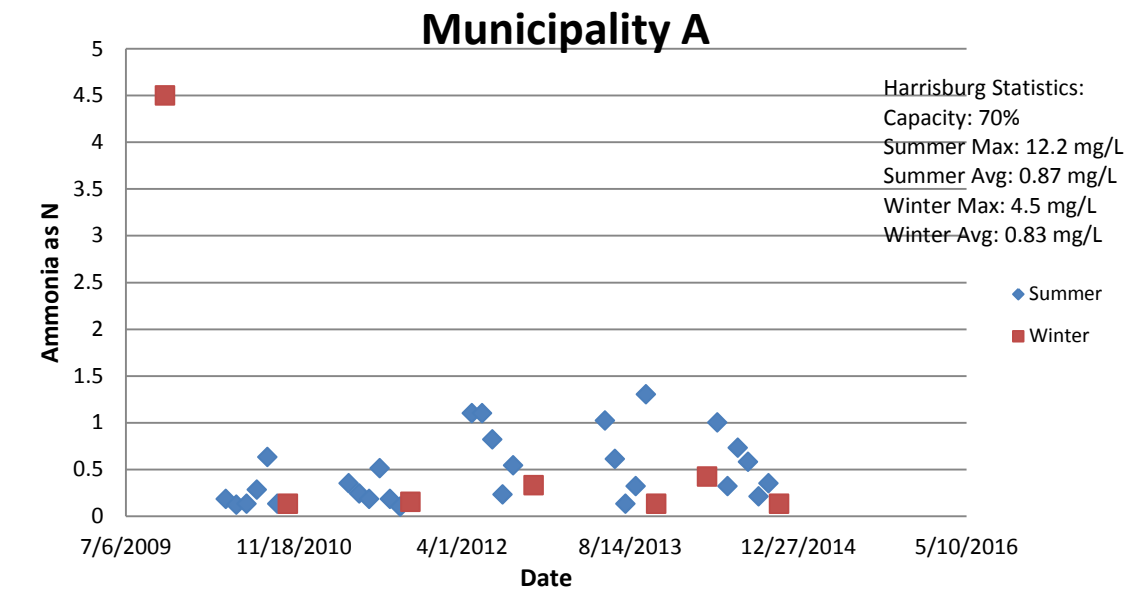
- Regularly schedule pump outs of the preliminary treatment (septic tanks) ;
- Remove vegetation from the filter bed; avoid chemicals to kill vegetation if possible;
- Check spray height to look for clogged dosing panels;
- Provide recirculation through the recirculation tank and pump at a minimum of 3:1 and if possible, increase the recirculation ratio to 4:1 or higher;
- Ensure loading is less than 5 gallons per day per square foot in dosing-if possible reduce that to under 3 gallons per day per square foot; and
- Replace media as necessary.

Through the department’s Operator Certification Program, classes are held on the operations and maintenance of RMFs; it is a recommendation that the operator attend for additional information on improving the operation and maintenance of their facility.

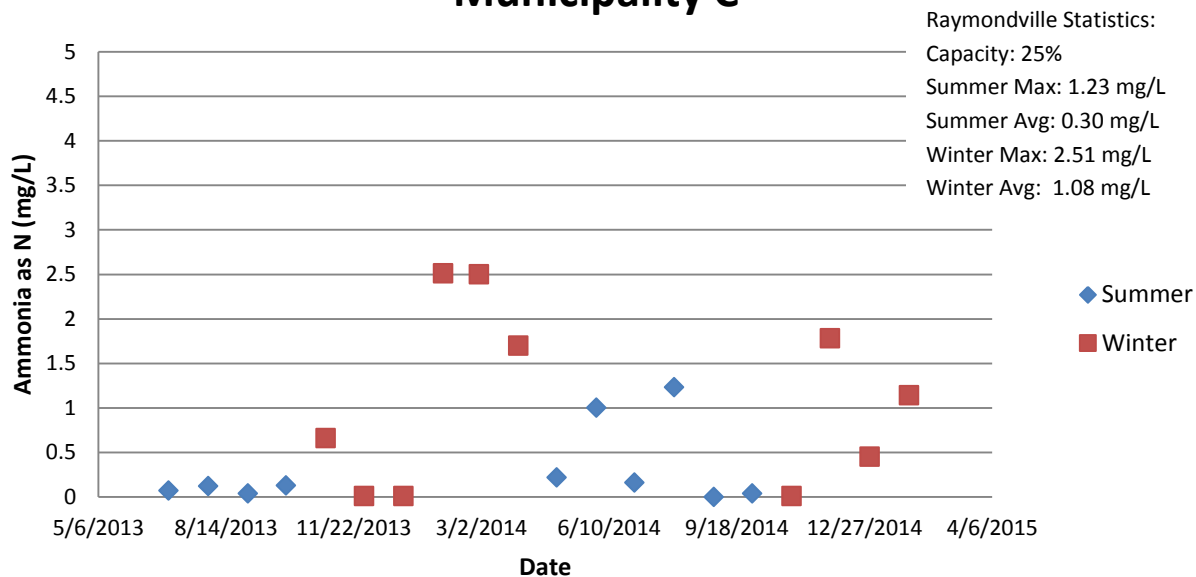
Conclusion:

For recirculating media filters, in review of the data, the highest attainable is meeting water quality standards.

Appendix A: Ammonia DMR summary from POTWs



Municipality C



Appendix C: References

EPA : http://water.epa.gov/infrastructure/septic/upload/finalr_7e6.pdf

Iowa DNR :

<http://www.iowadnr.gov/InsideDNR/RegulatoryWater/WastewaterConstruction/DesignGuidanceDocuments.aspx>

10 CSR 20-8.020: <http://www.sos.mo.gov/adrules/csr/current/10csr/10c20-8.pdf>

DRAFT